ELECTRICAL REVIEW

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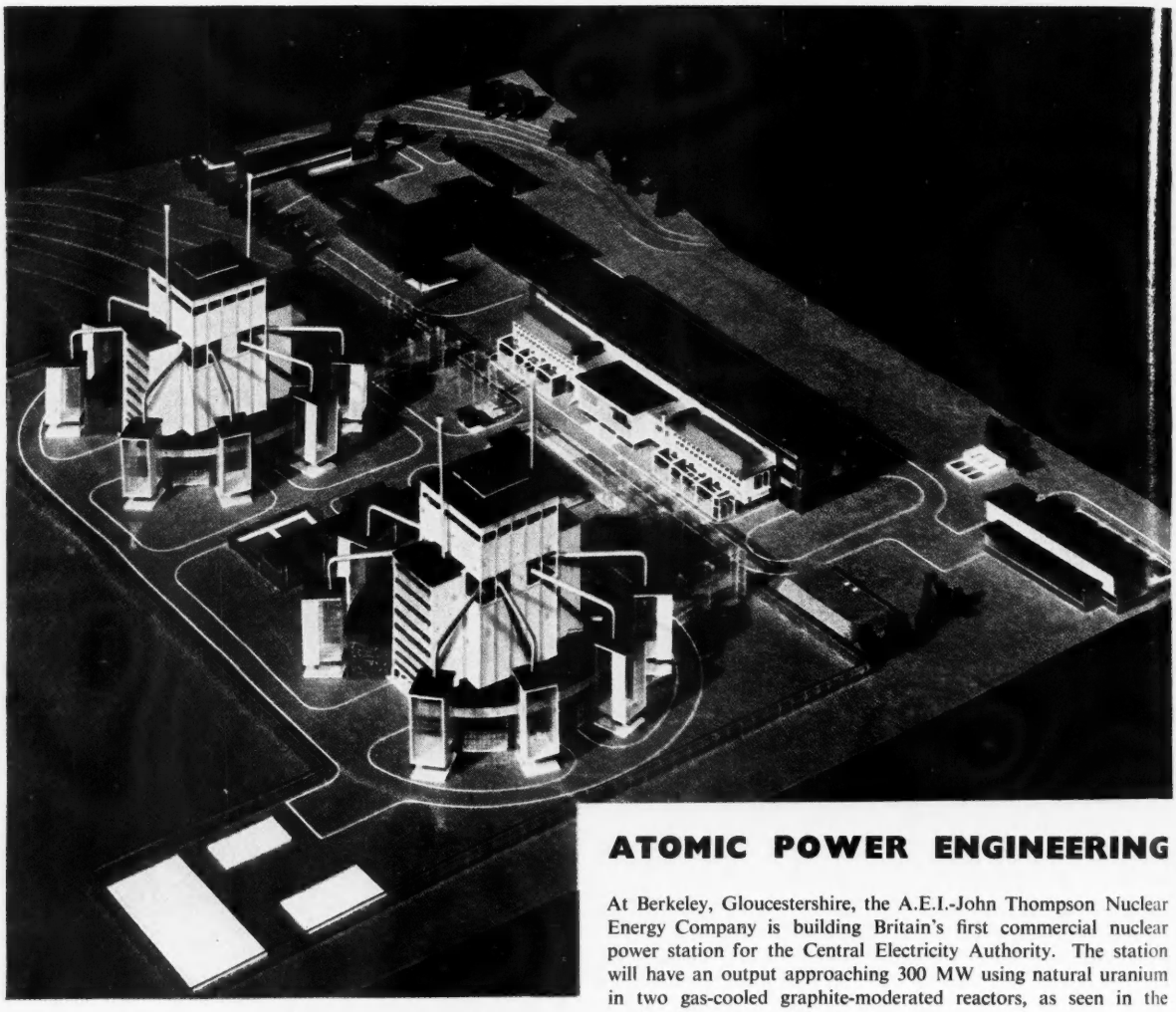

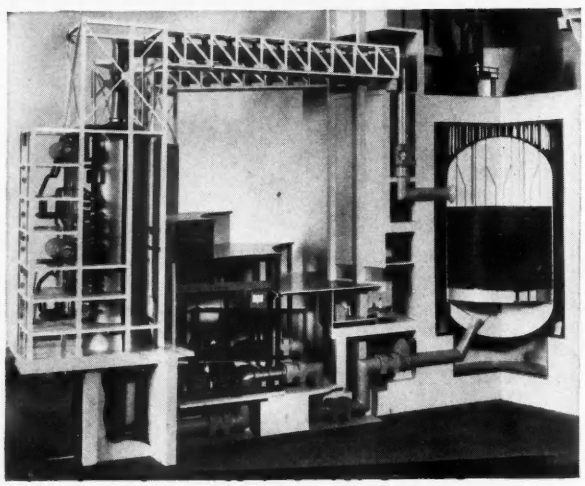

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The sectionalised model at left shows one reactor and one of the heat-exchange circuits.

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31 MAY
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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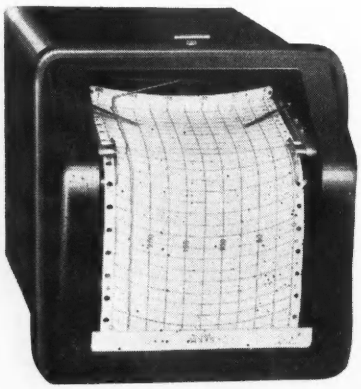

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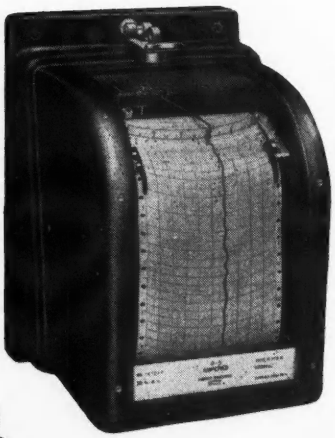

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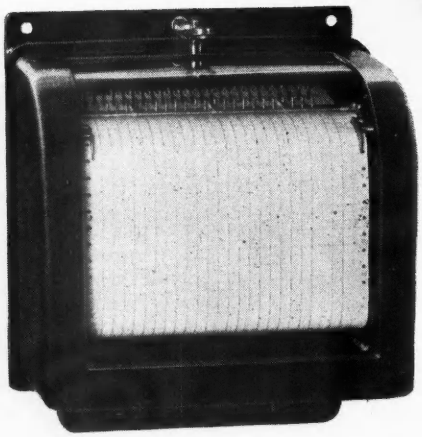

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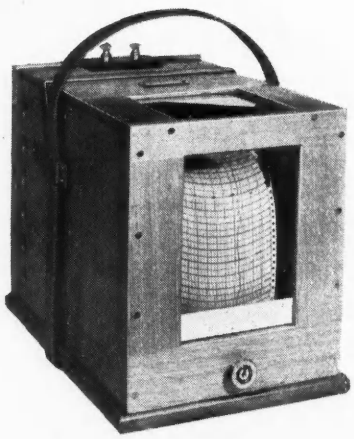

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ELECTRICAL REVIEW

31 May 1957 Vol. 160 No. 22 Established 1872

Closer Relationships

MOST of the matters discussed by Mr. A. V. Milton in his presidential address at this week's annual conference of the Electrical Contractors' Association were of common interest to all sections of the industry and many were even wider in their spread. Productivity, production costs, export trade, inflation, the Restrictive Trade Practices Act, etc., all came under review.

Relationships of the electrical contractors with the electricity supply authorities were briefly touched upon and Mr. Milton was right in insisting that the Area Co-operation Committees should be something more than a means of airing complaints. Their proper function is to create goodwill and understanding which should result in the gradual disappearance of grievances. The President sought for a more comprehensive way of discussing common problems than the sectional means which exist at present and he tentatively suggested that the Electrical Fair Trading Council's scope might be widened for the purpose, first taking in electricity supply representatives.

We doubt whether the Council's constitution and objects (which have been notified to the Registrar of Restrictive Trade Practices) could really be adapted to the object Mr. Milton has in mind. The British Electrical Power Convention was established for the purpose of bringing all sections of the industry together for the exchange of views. Maybe more frequent meetings of the Convention Council members—or some of them—could be arranged as a method of providing the " forum " envisaged by Mr. Milton.

Another possible way of achieving this is implicit in Mr. Milton's desire that the British Electrical Development Association should again be an all-industry organisation instead of being representative of the electricity supply section only. We have heard this suggestion made quite frequently in the past year or two and it would be very interesting and useful to have it discussed by those who favour it and those who do not. The pending reorganisation of the top layer of the electricity supply industry will inevitably involve consideration of E.D.A.'s future financing and operation.

Mr. Milton is not alone in deploring what he calls the dissipation of the industry's efforts in a host of exhibitions designed to appeal to the public. Most electrical people will agree that a good comprehensive central exhibition is the thing to aim at, but such an undertaking is more easily conceived than realised. It has been in mind for many years now, but the problems of space and money are formidable. But even if Mr. Milton's proposals are difficult of realisation they are not impossible and at any rate he has given the industry something to think about.

A YEAR'S PEACE?

The agreement reached last week by which workers in the engineering industry gain a 6½ per cent increase is estimated to add £70 million to the industry's annual wages bill. At a time when price is becoming an even more important factor in overseas trade this addition is unwelcome, although Mr. F. C. Braby, president of the Engineering & Allied Employers' National Federation, gave it as his view last week that the stabilisation of wages for a year was likely to help in the export drive as it would enable manufacturers to quote firm prices.

Again, if the agreement to observe obligations is faithfully observed the position both as regards home trade and exports should be considerably improved. If the unions cannot ensure this by exhortation they can at least exert their authority against unofficial stoppages.

One question appears to have been left unanswered. Does the " standstill " agreement apply to the unions' determination to press for a 40-hour week without loss of pay with all its implications?

ELECTRICITY IN FACTORIES

Despite the enormously extended application of electricity during the last ten years or so, the number of electrical accidents, as revealed in the latest report of the Factory Department (reviewed in this issue), has remained at an almost constant figure. Much is no doubt due, as the report implies, to the better class of installation work carried out in new factories and to the supersession of old wiring and equipment in reconstructed buildings.

An example of modernistic tendencies is the use of television to observe conditions at inaccessible points or within enclosures containing high-voltage apparatus. Some credit also should be given to a better educated appreciation of hazards by those responsible for design, maintenance and use of electrical appliances. That much remains to be done in this way is indicated by the fact that the greatest number of fatalities occurred at 250 V or less.

COMPUTER DEVELOPMENT

The grip which the electronic computer is gradually gaining on the industrial life of this country is evidenced by the fact that the London Computer Group has now completed arrangements to assist in the formation of other similar groups of members outside the London area. These groups will together act in association with each other, sharing common services, yet retaining their local autonomy and individuality.

This action follows a demand from many centres for some means of fulfilling the same objects as the London Computer Group: the opportunity for specialists in many fields, with some interest in the design, manufacture and use of electronic computers and data processing equipment, to meet together, as individuals and not at an official level, for the discussion of common problems and the exchange of knowledge and experience.

It will be recalled that the Group was formed at an inaugural meeting of some 250 people just under a year ago when a committee was appointed to create an organisation in the London area for those interested in the design, manufacture and use of electronic computers and to co-operate in the formation of any similar national organisation.

RUSSIAN WATER POWER

Despite great activity in exploiting hydro-electric resources in the U.S.S.R., no more than 4 per cent of the estimated potential is scheduled for service in 1960. The proportion would be less if so large a part of industry were not concentrated round the River Volga, of which full advantage is being taken in the provision of power.

An implication of the report by the delegation from the three British engineering institutions (reviewed in this issue) is that it has been found more economical generally to rely upon thermal stations of the most advanced type. This tendency indicates the handicap of great distances, even when commendable boldness is displayed in adopting the highest transmission voltages practicable. Nuclear power apparently is to be used mainly in areas where fuel is scarce. An anticipated consumption in 1960 of 1,520 kWh per head of population in the U.S.S.R., compared with 2,500 in Great Britain, seems to reflect a relative backwardness in domestic load development.

HANOVER—AND BRUSSELS

Drawing attention to the growing importance of the Hanover Fair in a letter to *The Times*, Mr. P. I. Paul-Huhne says that finance for extending the Fair is being provided by interest-free loans from potential exhibitors. He thinks that British electrical firms should participate in this on a " common basis." If by this he means that B.E.A.M.A. should take action it should be remembered that the Association is already heavily committed to support for next year's International Exhibition in Brussels and still needs contributions towards the cost from British electrical manufacturers.

Already the efforts of our industry are spread around many exhibitions—national and international—and it must be left largely to individual concerns to decide when and where they can display their products to the best advantage.

LESS FAVOURABLE TRADE

This country's export trade in April was lower than in the two preceding months and it was also below the figure for April, 1956. Exports of engineering products, exceptionally, were greater than in March, indicating that the engineering strike had little if any effect on overseas trade. In spite of this the electrical section recorded lower exports; indeed the figure was smaller than in the corresponding month of last year. Nearly all classes of electrical goods were affected, noticeable falls as compared with March being in the generating plant group, and in cables and wires. Despite this set-back the total value of exports for the four months of this year was still higher than for the corresponding period of last year.

DETERMINATION OF CHARACTERISTICS

By L. J. ARCHER, A.R.C.Sc.I., B.Sc., A.M.I.E.E.

PERHAPS the most difficult characteristic of any overhead line to determine is its current carrying capacity, that is the inherent current carrying capacity of the conductors, and not the current which may be carried by the line, determined from considerations of volts drop, line losses, or even stability. The inherent current carrying capacity of a conductor is determined by the upper temperature limit at which it may be worked, the ambient temperature, and other climatic conditions affecting the rate at which heat produced by the current can be dissipated.

It is difficult to determine suitable values for ambient temperature and the rate of heat dissipation from the conductor. The latter depends upon the wind velocity, exposure to the sun, and the size and surface condition of the conductor under consideration.

Butterworth[1] gives the formula $I^2R + \alpha s'd = H_c + E_s [(\theta + t + 273)^4 - (t + 273)^4] \pi d$ watts per cm, in which

- I = current rating in amps.
- R = a.c. resistance at operating temperature and current in ohms per cm.
- α = solar absorption coefficient (0·6 bright or 1·0 black conductors).
- s' = intensity of solar radiation in watts per cm^2.
- d = overall diameter of conductor in cm.
- H_c = convection loss in watts per cm.
- E = emissivity of conductor (1·0 for black conductors, 0·3 for s.c.a. bright, and 0·2 for other bright conductors).
- S = Stefan's constant = $5{\cdot}7 \times 10^{-12}$ watts per cm^2.
- θ = temperature rise of conductor above ambient in °C.
- t = ambient temperature in °C.

This formula is due to Hutchings and Parr[2] who give the following values for H_c:

$$Hc = \begin{pmatrix} 12{\cdot}8 \times 10^{-4} d^{0{\cdot}699} \theta^{1{\cdot}233} \text{ for stranded conductors} \\ 19{\cdot}5 \times 10^{-4} d^{0{\cdot}561} \theta^{1{\cdot}187} \text{ for smooth conductors} \end{pmatrix}$$

subject to natural convection.

$$Hc = \begin{pmatrix} 13{\cdot}8 \times 10^{-4} (Vd)^{0{\cdot}448} \theta \text{ for stranded conductors} \\ 15{\cdot}95 \times 10^{-4} (Vd)^{0{\cdot}462} \theta \text{ for smooth conductors} \end{pmatrix}$$

subject to forced convection produced by a wind having velocity Vcm/sec normal to the conductor. The above forced convection values are said to apply where V exceeds about 20, corresponding to 0·45 m.p.h.

Upper Temperature Limit

Forrest[4] gives a table which provides a useful guide to the current carrying capacity of various sizes of conductor in this country. The figures are based on a temperature rise of 30 deg C from an ambient temperature of 20 deg C with a wind velocity of 2 m.p.h. The resulting final temperature of 122 deg F he regards as the upper limit as it results in the maximum permissible conductor sag. It may be suggested, however, that if conductor sag is the criterion the temperature limit cannot be critical since increase of sag with temperature is not rapid, and there is usually a margin of ground clearance. On span lengths normally employed with copper conductors, the increase of sag between 50 deg C and 71 deg C will only be about a foot. On the span lengths normally employed for s.c.a. conductors the sag increase between these temperatures may be as much as 2ft 6in. Thus, on lines employing long spans the clearance aspect is more likely to be the important one and the question of heating in the clamps (mentioned later) may not be significant.

The regulations stipulate a minimum ground clearance *at 122 deg F*, and while this may be assumed to be a

minimum figure for all conditions, there is no specific direction to this effect. In any event to fix the upper temperature limit on this basis for a new line would seem to be allowing the tail to wag the dog. If other considerations suggest that a higher limit may be economically advisable, surely the line should be constructed to provide the desired clearance at that temperature, provided the additional cost does not vitiate the economic argument.

The ambient temperature of 20 deg C quoted above seems low. It may be conceded that maximum loads do not generally occur during times of high temperature, but engineers who have experience of operating a system which includes a holiday resort will probably agree that this cannot be taken as a universal rule.

Butterworth[1] gives comprehensive tables covering the current carrying capacity of various sizes of copper, s.c.a., and cadmium-copper conductors. His figures are based on an ambient temperature of 35 deg C, and cover temperature rises of 30, 40 and 50 deg C for copper and s.c.a. For cadmium-copper the temperature rises covered are 30, 50, 80 and 115 deg C. He states that the temperature limit of overhead line conductors is determined by the long time annealing temperature of the conductor material, and quotes an earlier E.R.A. report[5] as giving a figure of 75 deg C for copper and aluminium.

Further information on copper conductors is given by Preston and Taylor.[6] Curves indicate the loss of tensile strength in copper conductors plotted against time for various temperatures. It is shown that different samples of copper behave very differently in this respect, and this is attributed to the presence of small amounts of impurities, particularly oxygen. Swiss regulations allow a maximum temperature of 70 deg C for copper, determined by the long time annealing effect. A figure of 80 deg C is taken for "Aldrey," an aluminium alloy known as "Silmalec" in this country.

Preston and Taylor suggest 150 deg C for cadmium-copper, hence the temperature rise of 115 deg C for this material shown in the E.R.A. tables[1]. It seems improbable that the current density producing such a temperature could normally be tolerated on account of volt drop and line losses. It does appear, however, that for carrying abnormal overloads under emergency conditions a cadmium-copper line would show considerable advantages. The current rating shown by Butterworth[1] for 0·15in² cadmium-copper with a permitted temperature rise of 115 deg C is 747 A, against the 350 A usually considered reasonable for the same size of copper.

The above shows that there is a high degree of probability that overhead lines suffer an artificial ageing due to overloading, although there is no evidence to show that the effect is cumulative.

Overloads

Waghorne and Ogorodnikov[3] in a paper on current carrying capacities of s.c.a. conductors deduce a simplified equation (for cases where forced cooling occurs) suitable for plotting on a nomogram for determining current ratings. They claim that this formula gives a sufficiently close approximation having regard to the uncertain nature of many of the factors involved. The authors show a diagram comparing the current rating assigned to one size of s.c.a. conductor (i.e., 336·4 MCM ≃ 0·25in²) in various countries. The value which is recommended in England (450 A) is about the same as that for Germany and Canada. The value given for the U.S.A. is 10 per cent higher, and that for Russia about 14 per cent lower. The figure which the authors recommend themselves is much lower than any of these (270 A). They point out that this figure is a safe one applicable to the most unfavourable conditions likely to arise in the particular situation considered. Their paper presents a means of determining permissible overloads under abnormal operating conditions having regard to the climatic conditions. To assist in determining the wind velocity to be used with the nomogram they give a table, but it seems that, in any attempt to take weather conditions into consideration, an assessment based on ambient temperature would be safer.

A point which the American writers are careful to make, and one which is often overlooked here, is the effect of ferrous conductor clamps, which may cause local heating. This would in some cases limit the safe current to a lower figure than that calculated. Where the annealing effect determines the upper temperature limit, the local heating in some conductor clamps must be considered.

When considering overloads it is necessary to remember that many overhead lines are connected to underground cables, and that weather conditions which favour the uprating of the line conductors will have little or no effect upon the current capacity of the associated cables. It is also important to see that all connected cables have a normal current rating not less than that assigned to the line. Another difficulty arises because switchgear manufacturers have not so far assigned an overload capacity to their equipment. Although the current rating of the switchgear may greatly exceed that of the line, this must always be borne in mind.

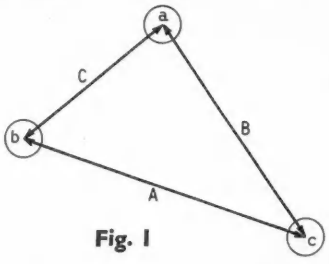


Fig. 1

Resistance

The heating effect of the current depends upon the conductor resistance. The d.c. resistance varies slightly with temperature, increasing by about 12 per cent in the case of h.d. copper and aluminium for a temperature rise of 30 deg C. In a.c. systems the a.c. resistance must be considered; this differs from the d.c. resistance by reason of "skin effect" in non-ferrous conductors. In ferrous and composite conductors the effect is more complex.

In composite conductors (s.c.c.* and s.c.a.) the a.c. resistance varies according to whether the number of layers of the conducting material is odd or even. This is due to the spiralling of the strands causing the current to travel round the magnetic core. If, as is standard practice, alternate layers are laid up in opposite directions, the a.c. resistance of such conductors having an even number of layers approximates to the d.c. resistance.

In the case of steel conductors little information is available. The a.c. resistance differs from the d.c. resistance on account of hysteresis losses in addition to the normal skin effect. The results of experiments on steel conductors of four grades and two sizes (No. 8 s.w.g. and 7/·104in strand) were published by E. C. Walton[7] in 1928. They reveal an appreciable variation in resistance with current. For a.c. at 50 c/s an increase of 28 per cent was indicated for one grade of No. 8 s.w.g. wire on increasing the current from 5 to 15 A. On the same grade of 7/·104in strand the corresponding increase in resistance was only about 14 per cent.

* S.c.c. conductors are not now in common use on account of the highly undesirable corrosion effect resulting from bimetallic action in which the steel is anodic. Thus the core is destroyed.

It is difficult to say how close a guide Walton's findings may be to the behaviour of steel conductors now normally available, since his experiments were prior to B.S. 183. Tables showing resistances of various conductors are given by Butterworth.[1]

Inductance

The inductance of two long parallel conductors is given by the formula $L = (741{\cdot}13 \log \frac{S}{r} + 80{\cdot}47\mu)10^{-6}$ henries per mile of circuit (i.e., one conductor), where S is the spacing between the conductors and r the radius of the conductor, both measured in the same units. The second term in the bracket represents the "internal" inductance of the conductor, μ being the permeability of the material. For non-ferrous conductors μ is unity and for a frequency of 50 c/s the equation reduces to:

$$X = 0{\cdot}02528 + 0{\cdot}2328 \log \frac{S}{r} \text{ ohms per mile.}$$

If, as is usual, S is measured in feet and r in inches we can write $\log \frac{24S}{d}$ in place of $\log \frac{S}{r}$, when d is the conductor diameter, the equation then becomes

$$X = 0{\cdot}3467 + 0{\cdot}2328 \log \frac{S}{d}$$

or $X = 0{\cdot}3467 - 0{\cdot}2328 \log d + 0{\cdot}2328 \log S$ .....(1)

The first two terms of this equation are the reactance per circuit mile *for unit spacing*.

For use with tables prepared by Butterworth[1] the above equation is further modified by using 100d in the second term and adding $2 \times 0{\cdot}2328$ to the first term.

Thus $X = 0{\cdot}8123 - 0{\cdot}2328 \log 100d + 0{\cdot}2382 \log S$. The first two terms are called X_1, and the third term X_2, thus $X = X_1 + X_2$. Values of X_1 are tabulated for conductor sizes from 0·05in to 0·5in, and values of X_2 for spacings from 1ft to 30ft.

Stranded Conductors

The above values of reactance are only strictly true for solid circular conductors. For stranded conductors a correction may be made by finding X for a conductor having a diameter equal to that of a single strand, and subtracting a term which depends upon the ratio of the overall diameter to the strand diameter. This correction depends only upon the number of strands in the conductor. The value of this correction factor is given by Butterworth[1] for non-ferrous conductors having 1 to 61 strands. He also gives a correction factor for s.c.a. conductors which, in this case, includes a correction for the permeability.

The table below has been prepared for various non-ferrous conductors. X_o and X_s are the reactances at one foot spacing obtained by using in the Butterworth tables the overall diameter, and the strand diameter with correction factor, respectively.

Non-ferrous conductor	X_o (using O/A diam)	X_s (using strand diam)	Difference $X_o - X_s$	Difference % of X_s
0·022in² 7/·064in	0·51351	0·52067	−0·00716	−1·37%
0·05in² 3/·147in	0·46313	0·47693	−0·01380	−2·9%
0·15in² 7/·166in	0·41713	0·42429	−0·00716	−1·69%
0·2in² 7/·193in	0·40190	0·40905	−0·00715	−1·75%
0·2in² 19/·116	0·40172	0·40450	−0·00278	−0·69%

The error is small in all cases; using the overall diameter results in a figure which is slightly low, but for normal use the figure is sufficiently accurate. The percentage errors shown are for one-foot spacing. For wider spacing the percentage error is much less.

Three-Phase Circuits

Under balanced conditions and with a completely transposed line, the above formula (1) holds for a three-phase circuit, if for S we substitute the equivalent spacing $S_e = \sqrt[3]{ABC}$ (*see* Fig. 1), A, B and C being the conductor spacings. If, however, the circuit is not transposed the three phases have different reactances. They also have an *apparent* increase (or decrease) in resistance which Butterworth terms "the power transference resistance." This increase of resistance must be included when volt drop is being calculated, but *not* when calculating losses.

With the conductor arrangement shown in Fig. 1, in which A is the distance between conductors b and c, and so on the equivalent spacings are $S_a = \sqrt{BC}$ for conductor "a," $S_b = \sqrt{CA}$ for conductor "b," and $S_c = \sqrt{AB}$ for conductor "c." These values of S should be used in the formula (1) to determine the reactances of the three conductors. The "power transference resistances" are given by $r_a = 0{\cdot}2016 \log \frac{C}{B}$, $r_b = 0{\cdot}2016 \log \frac{A}{C}$, and $r_c = 0{\cdot}2016 \log \frac{B}{A}$ for phase sequence a—c—b, i.e., the distance in the numerator is that from the conductor having a phase current which leads that in the conductor under consideration. For an opposite phase rotation the power transference resistance has an opposite sign. If $A = B = C$ then $S_a = S_b = S_c = S_e = S$ and $r_a = r_b = r_c = 0$.

Capacitance

In lines which are "electrically short" it is usual to ignore capacitance when estimating performance, but the inaccuracy introduced is not serious. The length of line for which this omission is permissible depends upon the frequency of the system. Butterworth and Forrest both state that for 50 c/s lines up to 100 miles long, capacitance may be ignored without serious error.

The capacitance between two long parallel conductors is given in electromagnetic c.g.s. units per cm by the expression:

$$C = \frac{1}{4v^2 \log_e \left[\frac{S}{d} + \sqrt{\left(\frac{S}{d}\right)^2 - 1}\right]}$$

"S" and "d" being the conductor spacing and diameter as previously, and "v" the velocity of propagation of the electric field in cm/sec. Since S/d is usually large $S^2/d^2 - 1 \simeq \frac{S^2}{d^2}$ and the expression approximates to $\frac{1}{4v^2 \log_e \left(\frac{2S}{d}\right)}$ which becomes $\frac{10^{15}}{4v^2 \log_e \left(\frac{2S}{d}\right)} \mu F/cm.$

If v is taken as 3×10^{10} and we change the log base to 10 and the length unit to a mile we get

$$C = \frac{0{\cdot}019415}{\log \left(\frac{2S}{d}\right)} \mu F/\text{mile}$$

The capacitance to neutral is twice that between phases,

so the susceptance to neutral becomes $b = 4\pi fC$, which at 50 c/s becomes $b = \frac{1}{0{\cdot}08187 \log \left(\frac{2S}{d}\right)}$ MΩ/mile.

The admittance Y of one conductor to neutral is $g + jb$ where g is the conductance of the shunt leakage path per cm, sometimes called the "leakance." Generally lines for which admittance calculations are necessary are so well insulated that "g" may be neglected, and the admittance Y becomes numerically equal to the susceptance. Thus we find Y called the susceptance. Using this notation and putting $\frac{2S}{d} = \frac{S}{r}$

$$\frac{1}{Y} = 0{\cdot}08187 \log \frac{S}{r} \text{ MΩ/mile.}$$

If, as is usual, S is measured in feet and d in inches the above expression becomes:

$$\frac{1}{Y} = 0{\cdot}08187 \log \frac{24S}{d} = 0{\cdot}08187[\log 24 + \log S - \log d]$$
$$= 0{\cdot}11299 - 0{\cdot}08187 \log d + 0{\cdot}08187 \log S \ldots\ldots (2)$$

Once again for use with the E.R.A. tables[1] this formula is modified to $0{\cdot}27673 - 0{\cdot}08187 \log 100d + 0{\cdot}08187 \log S$, the first two terms being called $\frac{1}{Y_1}$ and corresponding to unit spacing, while the third term, $\frac{1}{Y_2}$, is the spacing factor to be added to $\frac{1}{Y_1}$ to give $\frac{1}{Y}$. The tables give values of $\frac{1}{Y_1}$ for values of d from 0·05in to 0·5in, and of $\frac{1}{Y_2}$ for spacings from 1ft to 30ft.

Mr. P. d'E. Stowell has pointed out to the writer that since $\sqrt{XB} = \frac{w}{v}$ (where X is reactance, B susceptance, $w = 2\pi f$, and v is the velocity of propagation), if X is known B may be calculated without using the preceding equations or the tables, and while the above relationship is exact for very thin tubes (which have zero internal reactance), for solid conductors it is close enough for our purpose.

If v is the velocity of light, the frequency 50 c/s, and the unit of length the mile, $\frac{w}{v}$ becomes $\frac{100\pi}{186{,}300} = 1{\cdot}69 \times 10^{-3}$, from which $XB = 2{\cdot}85 \times 10^{-6}$.

If values of X and Y for solid conductors of various sizes and at various spacings are taken from the E.R.A. tables, it will be found that if the term representing internal inductance is subtracted from X_1 the value of XB (i.e., XY, since B has been equated to Y as mentioned earlier) is close to the above figure. If the deduction for internal reactance is neglected the value obtained for XB (or XY) is more nearly 2·93 (with Y expressed in megohms).

Stranded Conductors

In the case of capacitance no correction for stranding is proposed since its effect is negligible, but to cater for conductors exceeding 0·5in in diameter correction factors are tabulated for various strandings so as to permit the use of the single strand diameter with a correction factor. Alternatively, as may be seen from equation (2) for conductors exceeding 0·5in in diameter $\frac{d}{10}$ can be used in the table and 0·08187 subtracted from the result. (Or for greater accuracy use half the diameter and subtract 0·08187 log 2 = 0·02465). The above formula also holds under balanced conditions for a transposed three-phase circuit if for S the equivalent spacing $S_e = \sqrt[3]{ABC}$ is used.

Untransposed Three-Phase Circuits

For untransposed circuits the equivalent spacings are not the same for all conductors unless they are symmetrically arranged (i.e., at the corners of an equilateral triangle).

For the general case—and using the notation of Fig. 1—the equivalent spacings are given by

$$S_a = \frac{(\sqrt[3]{ABC})^2}{A}, \quad S_b = \frac{(\sqrt[3]{ABC})^2}{B} \quad S_c = \frac{(\sqrt[3]{ABC})^2}{C}$$

Analogous to the "power transference resistance" we have in this case an apparent conductance to neutral for each conductor. This is given in micromhos/mile at 50 c/s by the formulæ:

$$G_a = Y_a \left[\log \frac{B}{C} / \sqrt{3} \log \frac{S_e}{r}\right]$$

$$G_b = Y_b \left[\log \frac{C}{A} / \sqrt{3} \log \frac{S_e}{r}\right]$$

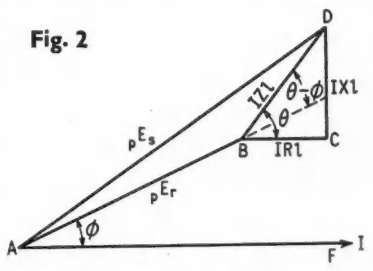
$$G_c = Y_c \left[\log \frac{A}{B} / \sqrt{3} \log \frac{S_e}{r}\right]$$

Here again $S_e = \sqrt[3]{ABC}$, and the apparent conductances have a positive sign for sequence a–c–b and a negative sign for the opposite sequence. As before, for equilateral spacing $S_a = S_b = S_c = S_e = S$, and $G_a = G_b = G_c = 0$. These susceptance formulæ are approximate since they neglect capacitances to earth, earth wire and supports. Because any line long enough to require the inclusion of susceptance values in performance calculations is almost certain to be transposed, the expressions given for un-transposed circuits are unlikely to be required in practice.

Voltage Regulation

In the case of lines for which line capacitance may be neglected the vector diagram is as shown in Fig. 2. Here AF is the direction of the current vector and ϕ is the receiving end power factor. AB is the receiving end phase voltage $_pE_r$, and AD is the sending end phase voltage $_pE_s$. BC, CD and BD are the voltage drops IRl, IXl and IZl respectively, where R, X and Z are the resistance, reactance and impedance per mile of line respectively, and l is the length in miles.

Fig. 2



$$\theta = \tan^{-1} \frac{X}{R}$$

Then $Z^2 = R^2 + X^2$, $R = Z \cos \theta$, $X = Z \sin \theta$

$$_pE_s^2 = {}_pE_r^2 + I^2Z^2l^2 + 2_pE_rIZl \cos(\theta - \phi)$$
$$= {}_pE_r^2 + I^2Z^2l^2 + 2_pE_rIZl [\cos \theta \cos \phi + \sin \theta \sin \phi]$$

Putting $_pE_r^2 = {}_pE_r^2(\cos^2 \theta + \sin^2 \theta)$, and $I^2Z^2l^2 = I^2Z^2l^2(\cos^2 \phi + \sin^2 \phi)$ this reduces to $_pE_s^2 = [_pE_r \cos \theta + IZl \cos \phi]^2 + [_pE_r \sin \theta + IZl \sin \phi]^2$

If the power delivered to the receiving end in MW is

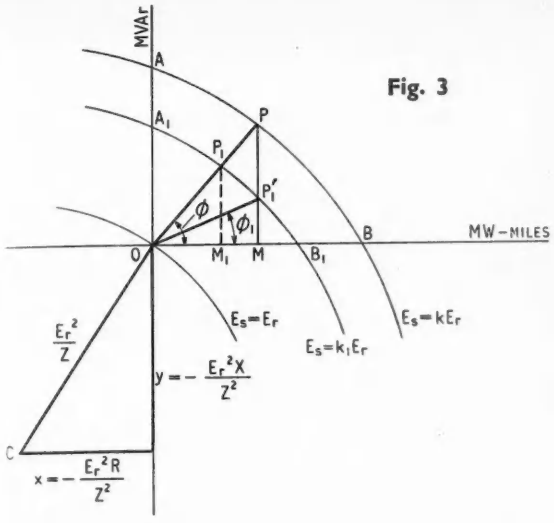


Fig. 3

called P, and the reactive power at the receiving end in MVAr is called Q

$P = 3_p E_r I \cos\phi \times 10^{-6}$ and $Q = 3_p E_r I \sin\phi \times 10^{-6}$

If now we call the sending end voltage *between phases measured in kV* E_s, and the corresponding receiving end voltage, also measured in kV, E_r, we have $E_s = \sqrt{3_p} E_s \times 10^{-3}$ and $E_r = \sqrt{3_p} E_r \times 10^{-3}$

Then
$$E_s^2 = (\sqrt{3} \times 10^{-3})^2 [{}_pE_r \cos\theta + IZ\cos\phi]^2 + (\sqrt{3} \times 10^{-3})[{}_pE_r \sin\theta + IZ\sin\phi]^2$$
$$= [E_r \cos\theta + \sqrt{3} \times 10^{-3} IZ\cos\phi]^2 + [E_r \sin\theta + \sqrt{3} \times 10^{-3} IZ\sin\phi]^2$$

and
$$\frac{E_s^2 E_r^2}{Z^2} = \left[\frac{E_r^2 \cos\theta}{Z} + \sqrt{3} \times 10^{-3} I \sqrt{3_p} E_r \times 10^{-3} \cos\phi l\right]^2 + \left[\frac{E_r^2 \sin\theta}{Z} + \sqrt{3} \times 10^{-3} I \sqrt{3_p} E_r 10^{-3} \sin\phi l\right]^2$$
$$= \left[\frac{E_r^2 \cos\theta}{Z} + Pl\right]^2 + \left[\frac{E_r^2 \sin\theta}{Z} + Ql\right]^2$$

Since $\frac{\cos\theta}{Z} = \frac{R}{Z^2}$ and $\frac{\sin\theta}{Z} = \frac{X}{Z^2}$, finally we have

$$\frac{E_r^4}{Z^2}\left(\frac{E_s}{E_r}\right)^2 = \left(\frac{E_r^2 R}{Z^2} + Pl\right)^2 + \left(\frac{E_r^2 X}{Z^2} + Ql\right)^2 \quad \ldots\ldots\ldots(3)$$

The Circle Diagram

If E_r is fixed and E_s variable, equation (3) is clearly that of a family of concentric circles. This is the basis of the well-known circle diagram for estimating overhead line performance, R, X and Z being the line resistance, reactance and impedance per mile, and Pl and Ql the MW-miles and MVAr-miles delivered.

In Fig. 3 the centre of the family of circles is placed at

$$x = \frac{-E_r^2 R}{Z^2} \qquad y = \frac{-E_r^2 X}{Z^2}$$

When $E_s = E_r$ the circle has radius equal $\frac{E_r^2}{Z}$ and it can be seen from equation (3) that Pl = 0, Ql = 0 satisfies the equation and corresponds to the point O. Values of Pl are measured along the x axis, and those of Ql along the y axis.

For other values of $\frac{E_s}{E_r}$ such as k and k_1 other circles are drawn, as shown at APB and $A_1P_1B_1$.

For any given value of ϕ (where $\cos\phi$ is the load power factor) a point P will be found on circle APB the perpendicular from which cuts the x axis at M. Then OM is the corresponding value of Pl, and PM the corresponding value of Ql. P is called the operating point.

If the sending end voltage is reduced to k_1E_r the power delivered for the same value of load power factor ($\cos\phi$) is reduced to OM_1. If ϕ can be reduced to ϕ_1 so that the operating point on circle $A_1P_1B_1$ becomes P_1', then the delivered power can be increased again to OM for the reduced value of E_s. PP_1' represents to scale the value of the leading MVAr-miles needed to produce the effect. That is to say, PP_1' divided by the line length in miles gives the MVA condenser capacity required to achieve this.

Construction of Chart

Having decided upon the type of construction (i.e., conductor arrangement), determine appropriate values for R and X for the conductor under consideration. X is found by the method already outlined. The co-ordinates of the centre C are then calculated; i.e.,

$$x = -\frac{RE_r^2}{Z^2} \text{ and } y = -\frac{XE_r^2}{Z^2}.$$

The radii of the various circles are $\frac{E_r^2}{Z}\frac{E_s}{E_r}$, and values of $\frac{E_s}{E_r}$ correspond to various volt drop percentages based on the *receiving end voltage*. Thus $\frac{E_s}{E_r} = 1{\cdot}02$ corresponds to 2 per cent volt drop, i.e., E_s = 102 per cent of E_r. The scale of the chart is in MW-miles and MVAr-miles. If it is proposed to use a scale of 1in = 50 MW-miles the values of x, y and radius are divided by 50 to fix the length in inches of these parameters.

Since the chart is scaled in MW-miles it will also serve for any line of the desired voltage having the characteristics R and X for which the chart is constructed. Furthermore, since the scale of the chart depends upon E_r^2, the chart can be used for a line having a different voltage (E_{r_1} say) if the values of Pl and Ql are multiplied by the factor $\frac{E_{r_1}^2}{E_r^2}$. This points the value of high voltage operation, the power delivered by a given line to a given load increasing as the square of the voltage.

As an example, let us suppose that the line in question is to deliver 33 kV three-phase at 50 c/s to the receiving end, and that the conductor arrangement is such that the equivalent spacing ($S_e = \sqrt[3]{ABC}$) is 4·74ft.

If the conductor to be considered is 0·15in² h.d. copper strand (7/·166in) the a.c. resistance at 50 deg C is 0·3293 Ω/mile. (The resistance at 50 deg C has been taken, as lines of this sort are likely to be fairly heavily loaded. For longer lines with lighter loadings the resultant estimate of performance will be somewhat pessimistic.) Using the E.R.A. tables[1] and taking d = 0·498in (overall diameter), X_1 for a solid conductor of this size is found to be 0·41713 and X_2 for 4·74ft spacing is found to be 0·15733. Thus $X = X_1 + X_2$ = 0·57446 Ω/mile. Had the *strand* diameter (0·166in) been used to find X_1 (0·52822) and the appropriate stranding factor for a seven strand conductor (X_c = 0·10393) been deducted from the result, the value of X obtained would have been 0·5812 Ω/mile. Taking X = 0·5745, $Z^2 = R^2 + X^2$ = 0·4385 and Z = 0·6622 Ω/mile. x = − 819 and y = − 1428. Radius = $1644\frac{E_s}{E_r}$.

If the more exact value 0·5812 had been used for X_1

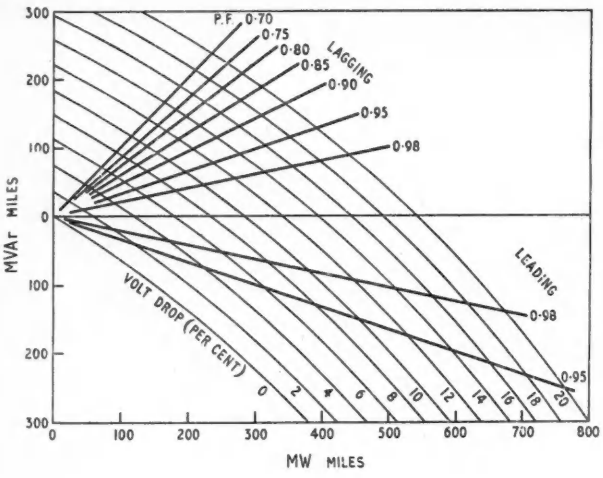


Fig. 4

the values of the above dimensions would have been $x = -804$, $y = -1418$ and radius $= 1630\frac{E_s}{E_r}$. It will be seen that the error in no case exceeds 2 per cent, and remembering that we are neglecting capacitance, the effect of which tends to cancel out some of the inductive reactance, it is obviously unnecessary to pretend to this degree of accuracy.

Fig. 4 shows a chart drawn from the above data. Taking a scale of 1in = 100 MW-miles, makes x and y −8·19 and −14·28in respectively. The centre C does not appear as its inclusion would result in a very large chart the greater part of which would be useless. Having plotted C, the various arcs having radii 16·44in, 16·44 × 1·02in, etc., to 16·44 × 1·20in are drawn. Through O a series of lines are drawn making angles $\cos^{-1}$ 0·98, $\cos^{-1}$ 0·95, $\cos^{-1}$ 0·90, etc., with the x axis, corresponding to these values of load power factor.

With unity load power factor the line in question will transmit 290 MW-miles for a 10 per cent volt drop. If the power factor is 0·9 the volt drop is about 17 per cent for this load, and if the volt drop is not to exceed 10 per cent only 170 MW-miles can be transmitted unless the power factor is improved at the receiving end.

If it is desired to transmit 300 MW-miles to a load having a 90 per cent power factor with a volt drop of 10 per cent, this may be done if 155 MVAr-miles of capacitance is provided at the receiving end, resulting in a slightly leading power factor. To find the capacitance required the figure of 155 must be divided by the line length as previously stated. Without this added capacitance the volt drop would be about 17½ per cent. The current carrying capacity of a 0·15in² bare h.d. copper conductor is usually taken as 350 A, representing 20 MVA at 33 kV three-phase. As previously pointed out, the current carrying capacity will vary according to conditions. If the figure of 20 MVA is accepted, the line under consideration could supply a 20 MW load having a 0·9 power factor over a distance of 12 miles, with an 8 per cent volt drop, if 9·6 MVAr of capacitance were provided.

If 20 miles long with the same added capacitance the line would have 14 per cent volt drop. For 8 per cent drop 16 MVAr would be required, giving p.f. 0·95 leading and about 5 per cent line overload.

Fig. 5 shows a similar chart drawn for the same line but with 0·1in² conductors.

Forrest[4] gives charts for various conductors and voltages ranging from 400 V to 132 kV for short lines. He also gives charts for certain long lines for 132 kV, 220 kV and 264 kV. In the case of long lines it should be noted that the chart is no longer scaled in MW-miles and MVAr-miles, and that a separate chart is required for each line. Forrest's charts are based on conductor spacings which are commonly used for the various voltages in question. In the case of lines for 33 kV and over, steel-tower lines are assumed, and the conductors considered are s.c.a. Forrest's charts for 0·10 sq in and 0·15 sq in 33 kV lines may be compared with Figs. 4 and 5.

Circle Diagram for Long Lines

For long lines in which capacitance is important the relation between ${}_pE_s$ and ${}_pE_r$ is given by

$${}_pE_s = {}_pE_r \cosh l\sqrt{YZ} + I_r\sqrt{\frac{Z}{Y}}\sinh l\sqrt{YZ}.$$

Also I_s is no longer equal to I_r, and is given by

$$I_s = I_r \cosh l\sqrt{YZ} + {}_pE_r\sqrt{\frac{Y}{Z}}\sinh l\sqrt{YZ}$$

where Z and Y are the series impedance and the shunt admittance per mile of one conductor, and l is the line length in miles. Equation (3) is now replaced by

$$\frac{E_r^4}{B^2Z^2}\left(\frac{E_s}{E_r}\right)^2 = \left(\frac{AE_r^2\cos(\theta + b - a)}{BZ} + Pl\right)^2 + \left(\frac{AE_r^2\sin(\theta + b - a)}{BZ} + Ql\right)^2 \quad ..(4)$$

in which $A = e^{-la}\cosh\sqrt{YZ}$ and $BZ = E^{-lb}\sqrt{\frac{Z}{Y}}\sinh\sqrt{YZ}$

If $\theta + b - a = \theta'$ and $BZ = Z'$ equation (4) becomes

$$\frac{E_r^4}{Z'^2}\left(\frac{E_s}{E_r}\right)^2 = \left(\frac{AE_r^2\cos\theta'}{Z'} + Pl\right)^2 + \left(\frac{AE_r^2\sin\theta'}{Z'} + Ql\right)^2 \quad ..(5)$$

If $Pl = Ql = O\left(\frac{AE_r^2}{Z^1}\right)^2 = \frac{E_r^4}{Z_1^2}\left(\frac{E_s}{E_r}\right)^2$ and $\frac{E_s}{E_r} = A$

Thus, the $E_s = E_r$ circle does not pass through O. Fig. 6 illustrates the construction. The co-ordinates of the centre C are $x = \frac{-AE_r^2\cos\theta'}{Z'} = CN$, and $y = \frac{-AE_r^2\sin\theta'}{Z'} = ON$,

while the radius is $E_r^2/Z' = CA$. The circle cuts the Y axis at A and $OA = CA(\sin\theta'' - A\sin\theta')$. There is no longer any advantage in scaling the diagram in MW-miles since the values of x, y and OA now vary with line length,

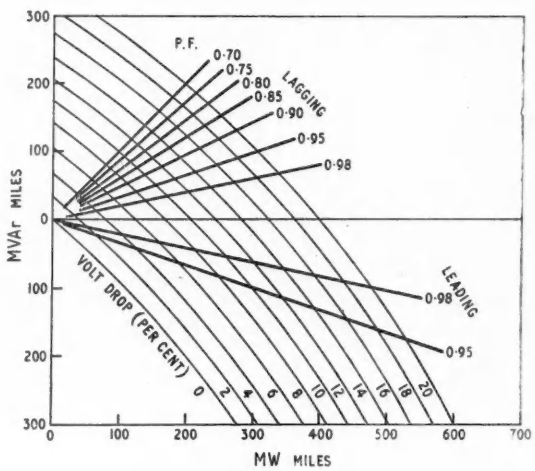


Fig. 5

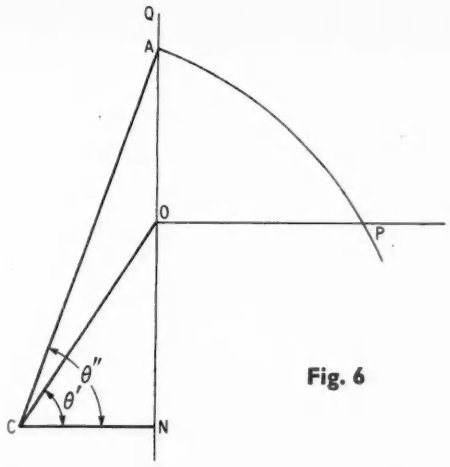


Fig. 6

and, as stated previously, a special chart is required for each line.

Butterworth[1] gives series formulæ for calculating OA, Z′ and cosθ'', thus permitting the construction of the diagram, i.e., $CA = E_r^2/Z'$, $CN = CA\cos\theta''$, $AN = CA\sin\theta''$.

Ryle in a paper presented at the C.I.G.R.E. meeting in 1948[8] describes a "circle diagram board" which avoids the tedium of constructing a diagram for each line, and is readily set up to enable the performance of a particular line to be estimated. He also describes an approximate method of determining line constants by the use of "line length factors." This is accurate enough for lines up to about 400 miles long. Ryle's formulæ (using a slightly different notation) are as follows:

$$Z'' = Z(1 - aL^2) \quad Y'' = Y(1+bL^2) \quad \frac{R''}{X''} = \frac{R}{X}(1 - cL^2)$$

where R, X, Z and Y are the *numerical* values of the total (*not* per mile) line resistance, reactance and impedance in ohms, and the admittance in mhos, respectively, and L is the line length in *hundreds* of miles. Z″, Y″ and $\frac{R''}{X''}$ are "equivalent π" values; i.e., Z″ is the architrave impedance and $\frac{Y''}{2}$ the admittance of the pillars of the π network which gives the same *terminal* conditions as the actual line. $Z'' = Z\frac{\sinh\sqrt{YZ}}{\sqrt{YZ}}$, $Y'' = Y\frac{\tanh\frac{\sqrt{YZ}}{2}}{\frac{\sqrt{YZ}}{2}}$

where Y and Z are total (not per mile) values. For a frequency of 50 c/s a = 0·005, b = 0·0025 and c = 0·0056. With these values the dimensions of the diagram shown in Fig. 6 are:

$$AO = \frac{E_r^2 Y''}{2} \quad AN = \frac{E_r^2 X''}{Z''^2} \quad CN = \frac{E_r^2 R''}{Z''^2}$$

$CA = \frac{E_r^2}{Z''}$ from which (noting that $\frac{CN}{AN} = \frac{R''}{X''} = \tan CAN$) the diagram may readily be constructed.

It will be observed from Fig. 6 that in the case of long lines small amounts of power can be transmitted with values of E_s less than those of E_r. It is of course well known that at light loads there is a rise of voltage at the end of a long transmission line.

It should be mentioned that Ryle's circle diagram board can also be used for investigating the performance of short lines.

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[1] E.R.A. report O/T4.
[2] E.R.A. report O/T5.
[3] A.I.E.E. Technical Paper 51-195 (1951).
[4] Overhead-line Charts. J. S. Forrest. (Electrical Review Publications, Ltd.)
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[6] Preston, G. W., and Taylor, H. G. J.I.E.E. 1944, V91, PII, p. 451.
[7] Walton, E. C. J.I.E.E. 1928, V66, p. 1065.
[8] Practical Long Line A.C. Transmission Calculations. Ryle, P. J. C.I.G.R.E. 1948. No. 402.

Safety in Atomic Energy

THE Atomic Energy Authority Act 1954 places on the Atomic Energy Authority the duty of securing that no ionising radiation from any of their premises or from any waste discharged from their premises shall cause any hurt to any person or damage to any property. The Authority have carried out their responsibilities under this Act through a number of committees dealing with the various aspects of safety policy. These bodies have now been organised in a new structure consisting of two main committees which will be served by a newly formed Safety Branch.

The new Branch will meet the Authority's need for a permanent staff to serve this Committee structure and will operate from the headquarters of the Industrial Group at Risley. It will draw on the resources of all Groups of the Authority for both information and specialised work. It will provide the focus for consideration not only of the Authority's own proposals but also of industrial proposals put to it either directly or through Government departments.

It will service the main committees and sub-committees and will furnish the inspection service which will be needed to ensure the maintenance of safe working within the Authority. It will provide technical advice in the legislative field and draft, with the committees, codes of practice in design and operation.

The existence of the Authority's safety organisation will not, of course, affect the assumption of responsibilities by Government Departments concerned as soon as the time is proper. It has been developed to enable the Authority to keep under continuous review all factors affecting safety in nuclear development, to advise Government departments concerned with legislation, as well as to advise other users of the Authority's own growing organisation. It will undertake rigorous scrutiny of all proposals for reactors and within the Authority for all other process plants and other laboratory installations capable of introducing hazards. The Authority has appointed Mr. F. R. Farmer to the post of Chief Safety Officer to take charge of the Safety Branch.

Institute of Automation

The Institute of Automation held its inaugural meeting on Saturday, 18th May, at the Lecture Hall of the Junior Institution of Engineers. The president, Mr. W. V. Tipping, addressed the meeting on the Institute's aims and objects, following which there was a discussion.

N.P.L. OPEN DAYS

NOTEWORTHY WORK IN PROGRESS

LAST week the National Physical Laboratory held open days for representatives of industry, scientific and educational organisations and the Press to enable them to see something of the work in progress.

The Control Mechanisms and Electronics Division has the new ACE automatic computing engine, the design of which is based upon experience gained from the experimental ACE pilot model and also from the DEUCE which is an engineered version of the ACE pilot model. The new machine will be a much more powerful computing tool than its predecessors by virtue of its increased speed, of its larger storage capacity or "memory" and of its many additional functional facilities.

In a typical day's working this computer will average 20,000 three-address operations per second, and its speed on a number of programmes already constructed is estimated to be about eight times that of the DEUCE. The mercury delay lines and magnetic drums will store a total of $1\frac{1}{2}$ million binary digits. This will allow the solution of very complex problems which have hitherto been beyond the capabilities of existing computing machines.

A digital plotting table has been developed which plots graphs automatically from information recorded in digital form. With suitable reading equipment, this information could be obtained from sources such as punched cards or punched paper tape—the usual types of output of a digital computer. Points are plotted with an accuracy better than 0·01in and closely spaced points are plotted at the rate of two per second. Full scaling and zero shift facilities enable any range of input numbers to be fitted to any desired size of graph paper. Transistors and printed circuit techniques have been used extensively throughout the equipment.

Testing Transformer

A new testing transformer, rated at 700 kVA and designed to give a single-phase output of one million volts when supplied at 1,200 V, has been installed in the place of the three air-insulated transformers put in when the laboratory was erected in 1926. The winding of the transformer is immersed in oil in a steel tank, the whole assembly weighing about 55 tons. The tank is connected to the centre point of the h.v. winding, and as it is always at half the output voltage it is insulated from earth by three pairs of porcelain columns; these columns can withstand 500,000 V without flashover. Two 500,000 V bushings are fitted to the tank, one for the supply to the primary winding and the other for the output. A million volt porcelain wall bushing 36ft long and weighing four tons is mounted in the north wall of the laboratory so that the full output of the transformer can be used inside the building. Additional equipment includes two steel towers for supporting insulator strings under test, and a new rain-spray apparatus to enable flashover tests to be carried out on insulators, etc., under artificial rain conditions.

The N.P.L. atomic clock which has been used to check the drift rates of precision quartz clocks and the variation in the rate of rotation of the earth has been still further improved. The clock is now capable of determining frequencies with an accuracy of one part in ten thousand million in a measurement lasting only a few minutes. A new model which possesses still greater reliability and simplicity of operation, together with a higher accuracy, is in course of construction.

Differential Analyser

The Mathematics Division of the Laboratory has a large, servo-connected differential analyser. One of the important fields of application of this equipment is to problems concerned with engineering and technological design. It is possible to set up the analyser to represent each of the individual physical components of a complex assembly so that the originator of the problem can study the behaviour and improve the design before attempting to manufacture his apparatus. Many problems have been tackled in such diverse fields as aircraft design, servo-mechanisms and automatic control, electronics and electrical circuits, radio propagation, physiology, etc., as well as the purer aspects of physics and mathematics.

An investigation into the measurement of the structural damping of a 425ft concrete chimney stack was carried out at Ferrybridge "B" power station by the Aerodynamics and Physics Divisions in collaboration with the Royal Aircraft Establishment. Aerodynamic data for various shapes of stack have been found by wind tunnel investigations, but hitherto there has been no precise information on the structural damping of a concrete stack. The measurements described were made primarily to obtain information from which the tendency of polygonal and other new designs of chimney stack to oscillate could be predicted from aerodynamic data.

In the test the stack was set in oscillation by firing thrust units from the top and the decay of the vibration was recorded in a mobile laboratory at the base. The vibration was measured in two perpendicular planes by means of piezo-electric accelerometers installed at the top.

The outputs were fed to the mobile laboratory by 200 yd cables, where, after double integration and amplification of the signals, the displacements were recorded on a two-channel pen recorder. The equipment is suitable for measurements down to frequencies of 0·5 c/s and an amplitude of 0·001in can be detected.

Thermal Comparator

In this age of jet propulsion and atomic power, knowledge of the thermal properties of materials is of considerable importance. The methods normally used for determining thermal conductivity are rather complex and time-consuming. The Physics Division has developed the thermal comparator, a device for the rapid measurement of the thermal conductivity of solids, the estimation of film thickness and the examination of surface properties. It offers a simple comparative method which, from observations taking only a few seconds, can furnish approximate values for the thermal conductivity of any sample having a hard, smooth surface. The method is based on the common experience that by merely handling solids at normal temperature they can be roughly graded in order of their thermal conductivities. Good thermal conductors abstract more heat and thus feel colder than poor conductors.

ELECTRICAL ACCIDENTS IN FACTORIES ANALYSED

ELECTRICAL SAFETY

THE publication of the Ministry of Labour and National Service entitled " Electrical Accidents and Their Causes " for 1955 is now available (73 pages and 7 plates, H.M. Stationery Office, 4s). It records that the number of such accidents reportable under the Factories Acts (i.e., entailing three days' disablement) was 739, of which 42 (25 up to 250 V) were fatal, compared with 707 and 33 in 1954. In addition, 59 known fatalities occurred in other industrial or similar premises and 41 in domestic or similar premises, bringing the aggregate of fatalities up to 142 (122 in 1954).

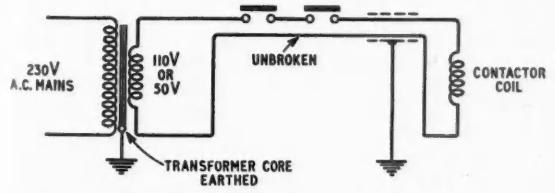
Classification of Accidents

Of the 611 accidents, excluding eye-flash from welding (128 cases), 193 (19 fatal) were caused by portable apparatus and cables, mainly among unskilled people, and 200 (six fatal) were associated with transformers, switchgear and fuses, mainly among electricians. In 341 instances involving electric shock, 100 caused injuries (five with fractured skulls) from falling. In 401 mishaps which resulted in burns, 131 were accompanied by shock. Artificial respiration was applied to 40 out of 60 unconscious persons and 19 recovered. Ignorance, carelessness or neglect resulted in 275 accidents, for one-third of which the injured person was not responsible. Faulty planning and supervision of work in high-voltage substations and unclear instructions were frequent causes. Brief descriptions are given in the report of failures of explosive violence and/or causing fire, sometimes accompanied by personal injuries.

The need to protect temporary wiring during building work is emphasised, and no relaxation of the statutory Regulations is allowable on account of its non-permanent character; indeed such wiring should be mechanically more robust than ordinary rubber-insulated cables. The most practicable way of reducing risks is to employ a 110 V supply for all lighting and portable apparatus.

Positioning of Limit Switch

Automatic controls, it is pointed out, should always " fail to safety " (the elements of which are illustrated in the accompanying diagram), a requisite that is not always met by a switch relying on springs. The position of a limit switch and the manner of its connection also have an important bearing on its safety; examples of right and wrong methods are given in the report. Sticking contactors with shunt over-wind switches are an increasing cause of crane accidents; either a series arrangement or two-pole contactors should be adopted. Moisture or dirt in recessed brush holders of portable tools has resulted in current leaks to earthed metal cases that are insufficient to blow the fuses, in one case causing death.



Connections to contactor illustrating the "fail to safety" principle. Leads covered by metallic earth screen, e.g., conduit, and run as a pair throughout

APPARATUS INVOLVED IN REPORTABLE ACCIDENTS

Apparatus	Fatal		Non-Fatal		Total
	Men	Women	Men	Women	
Portable Apparatus:					
Electric machines	6	—	53	4	63
Heaters and irons	—	—	4	5	9
Lamps	2	—	9	1	12
Test sets including lamps, etc.	1	—	19	—	20
Plugs, sockets and adaptors	3	—	33	1	37
Cables and flex	6	—	25	2	33
Electric hand welding:					
(a) Shock and/or burns	1	—	18	—	19
(b) Eye injuries	—	—	128		128
Fixed Apparatus:					
Electrical machines	—	—	13	2	15
Transformers	1	—	1	—	2
Switchgear above 650 V:					
(a) Switchboards	3	—	48	—	51
(b) Motor or other control apparatus	—	—	1	—	1
Switchgear below 650 V:					
(a) Switchboards	1	—	64	—	65
(b) Motor or other control apparatus	1	—	50	2	53
Fusegear	—	—	28	—	28
Crane trolleys and collectors	6	—	36	—	42
Fixed lamps	1	—	17	2	20
Cables for fixed apparatus	4	—	78	4	86
Test leads	—	—	18	3	21
Overhead transmission and distribution lines:					
(a) Contact by cranes or similar machines	4	—	2	—	6
(b) Direct contact or contact through materials handled	1	—	7	—	8
Apparatus not classified	1	—	14	5	20
Total	42	—	538	31	739
			Plus 128 eye-flash accidents (welding)		

The current waveform of fluorescent lamps allows of currents in the neutral of a three-phase four-wire supply that may be 50 per cent greater than in the line. Addition of capacity to improve power factor worsens the position, for example, a ratio of neutral-to-phase current of 20 per cent became 47 per cent after correction to a p.f. of only 0·8.

Accidents still continue to arise out of the connection of single-pole switches or fuses in an earthed neutral. Other dangerous practices are the taking of a single-phase circuit from a three-wire three-phase circuit, making a return connection via the earthing system in the absence of a neutral, or the " borrowing " of a neutral from another circuit.

Reliance solely on key interlocking systems of relays or contactors is deprecated for enclosures containing high-voltage apparatus of high-frequency metallurgical furnaces. Mechanical interlocking of either the main incoming circuit-breaker or an isolator between the h.f. generator and the furnace equipment has been successfully applied. Alternatively, if relay interlocking is retained, a robust earthing switch can be fitted and held in position so long as the enclosure door remains open.

Power operation, as distinct from hand closure, of all 6·6 and 11 kV circuit-breakers above 150 MVA rating and of all breakers above 11 kV is welcomed as a definite step forward.

NEW BOOKS

Data Book on Electric Motors. By E. Molloy. Pp. 168; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 12s 6d.

This handy little book contains a good deal of information on both motors and control gear. After a general survey of types of d.c. and a.c. motors it deals with such aspects of motor operation as permissible temperatures of various classes of insulation, enclosures, choice of motors, protective devices and terminal markings. The important subject of starting methods is well covered and illustrated by diagrams of connections of representative types of modern starters. A chapter is devoted to the related subject of speed control and reversal, though this might well have been amplified to explain how the rated torque is affected when the speed is changed. The notes on fault location will be useful to many readers, as will also the tables relating to full-load currents, current rating of cables and fuse wires, approximate running costs, power factor improvement, etc.

The book is not intended to be a theoretical treatise and the author has concentrated on practical information. It would, however, have been of more value had it been checked more carefully before publication. Fig. 11 on page 21 may not be clear to all readers, the term resistance is used instead of impedance in one place, and some of the tables on motor characteristics appear rather contradictory. The book also contains a few statements which require qualification. The notes on armature faults ignore the effect of an earthed point on the system external to the armature. In another place one of the methods of improving power factor is given as a small motor running light connected in parallel with a suitable section of load. Apart from such indications of lack of care the various aspects of motor operation are well covered.—J.L.W.

Digital Calculating Machines. By G. A. Montgomerie, B.Sc., A.M.I.E.E., A.M.I.Mech.E., Assoc.I.R.E. Pp. 262; figs. Blackie & Son, Ltd., 17, Stanhope Street, Glasgow, C.4. Price 30s.

This book deals with all the different types and classes of digital calculating machines from the Chinese abacus, still widely used in the Far East, to the most modern of the universal electronic variety. A complete survey of the various machines is given together with sufficient detail of each type to enable one to understand the mechanical working details and the arithmetical processes involved. The symbolism used is straightforward and is introduced very easily with good explanations and many examples. It should be acceptable to anyone understanding arithmetic.

There are two aspects of computing machines, the first being that of the engineer who requires to know what happens in a physical sense, and the second, that of the mathematician or user who requires to know the method of operation in arithmetical terms. In the main, the book deals with both these sides in an interesting and logical manner. One feels that further details would have been too much, and the author has not let it become either a handbook for operators or a maintenance manual.

A quarter of the book is devoted to the fast electronic digital calculators developed in the last fifteen years. The various forms of digital number representation are dealt with, special attention being given to arithmetical operations in the binary system, the final chapter dealing exclusively with "programming." Such machines as the ENIAC, Hollerith and Ferranti machines are described and many photographs are included. At this stage the physical and electronic mechanisms are only lightly touched upon. No circuitry is included and no electronic knowledge is required. This is as it should be; the design and maintenance of these machines is for the electronic specialist and this side is well catered for in other literature.

The book is well produced, the photographs and drawings are good, there is an adequate index and recommended books for further more specialised reading are given at each chapter end.—J.C.W.

Applied Electrical Measurements. By I. F. Kinnard. Pp. 600; figs. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 120s.

The field of electrical measurements is extremely vast, because it includes not only the measurement of the familiar electrical quantities, such as voltage, current, etc., but also a large variety of non-electrical parameters which occur in other branches of science and engineering. The rapid growth of the application of electrical methods of measurement to non-electrical quantities is due largely to the advances in electronic technique which have taken place in recent years. Thus the development of a basic instrument such as the electronic counter has resulted in the production of a family of derived instruments which may be used for such diverse purposes as the measurement of frequency, and the counting of articles such as cans of beans. The scope of Dr. Kinnard's book is very wide, and perhaps as one would expect of a work to which several people have contributed, the standard of treatment is somewhat varied. Thus, it is a little surprising to find that thirteen pages are devoted to moving iron indicating instruments, whilst the definition and measurement of capacitance is dismissed in little more than one page.

The book is essentially descriptive, and is intended to provide an outline of the basic techniques available in the various fields of physical measurement, but in some cases the descriptions of equipment are hardly indicative of current practice, and may even be misleading. For example, in the description of the waveform generated by the linear time base of a cathode-ray oscilloscope, it is stated that: "This type of waveform is generated by charging a capacitor and allowing it to discharge through a gas filled tube."

In the writer's opinion, a more detailed treatment of the subject would be worth while, even at the expense of producing the work in two volumes.—H.B.W.

BOOKS RECEIVED

The j Operator for Electrical Engineers. By Philip Kemp, M.Sc.Tech., M.I.E.E. Pp. 135; figs. Macmillan & Co., Ltd., St. Martin's Street, London, W.C.2. Price 21s.

National Certificate Electrical Engineering. By R. Bourne, B.Sc.(Eng.). Pp. 370; 212 figs. MacDonald & Evans, Ltd., 8, John Street, Bedford Row, London, W.C.1. Price 22s 6d.

Radio and Components. Vol. IV. Variable Capacitors and Trimmers. By G. W. A. Dummer, M.B.E., M.I.E.E. Pp. 169; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 32s 6d.

TWENTY-ONE years have passed since the Electrical Contractors' Association last held its annual conference at Llandudno, but although the membership has naturally changed considerably in that time many of the E.C.A. stalwarts of that day reappeared at this week's gathering. Llandudno is a pleasant, well-situated town and the weather was kind.

Registration of delegates on Sunday afternoon was followed in the evening by a " Get Together " at the Grand Hotel, although a good many had already " got together " during the day. In accordance with the usual practice, the business side of the Conference opened on Monday morning at the Pier Pavilion with a civic welcome by the Chairman of the Llandudno U.D.C. (Councillor C. R. Payne).

Councillor Payne briefly reviewed Llandudno's history and in the course of his remarks mentioned that his father was Chairman of the Urban District Council at the time of the Association's first visit—in 1930. Among his references to the town's electrical affairs was one to the electrification of the Great Orme funicular railway.

The President, Mr. A. V. Milton, Associate I.E.E., thanked Councillor Payne and then proceeded to read his address, a summary of which follows:

Mr. A. V. Milton's Review

IN his presidential address, Mr. Milton asked the question " Just where does the duty of the modern industrial association lie ? " and answered it by saying that such an association had to work for the benefit of its members, always bearing in mind that selfish actions which were against the national interest or the interest of the industry of which which it was part, must ultimately be to the detriment of the members themselves.

Mr. Milton considered that no industry in the country had so diverse interests as electrical contracting, a

Mr. A. V. Milton delivering his presidential address on Monday morning

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1.—Mrs. C. H. Alger, Mrs. A. O. Bruty, Mr. Alger and Mr. Bruty. 2.—Mr. J. F. C. Prosser, Mrs. J. G. Briggs, Mr. H. K. Prosser, Mrs. J. F. C. Prosser and Mr. J. G. Briggs. 3.—Mr. and Mrs. T. K. Richardson. 4.—Mr. S. Dickinson, Mrs. J. G. Briggs, Mr. V. Ferens, Mr. J. Gibson and Mr. A. S. Lowrey. 5.—Messrs. P. Poynton and J. Pinnington. 6.—Mr. and Mrs. H. C. Linacre and Mr. and Mrs. W. Winstanley. 7.—Mr. and Mrs. J. Mortimer Hawkins. 8.—Mrs. W. E. Potter and Mr. and Mrs. A. E. Chesters.

diversity which was a reflection of the extent to which electricity entered into all aspects of the national life. The big challenge to them was the necessity to ensure that economy and efficiency kept pace with technical developments and there was an essential need to increase production. Productivity was bound up with full automation which, in effect, was the greater use of electric power.

The world leadership which this country enjoyed in the development of nuclear power for peaceful purposes must be maintained if we were to be successful in the export field. There was an almost insatiable international demand for manufactured products, but although our exports showed a gradual increase other industrial nations were securing a proportionally greater share in the world's markets.

With increased mechanisation the electrical contracting industry had every reason to expect an increased output per man-hour but it had not been achieved. So far they had been unable to produce a practicable scheme of payment by results but the subject was again under consideration. It seemed impossible to get a broad public appreciation of the fact that increased production and stabilisation would solve the country's economic problems and secure an improved standard of living.

The labour ingredient in the products of the electrical industry was large and in addition to the high cost of production there was purchase tax at a rate which could no longer be justified. The tax was imposed by reason of the shortage of generating plant but that reason was no longer valid and they had the right to expect the tax to be removed. It was retarding progress and acted against the improvement of the people's standard of living.

He had yet to discover what beneficial effects the Restrictive Trade Practices Act and the reports of the Monopolies Commission would have. They had been advised that some activities of their own Association and those of many similar organisations to secure proper and fair trading conditions were no longer permissible. It seemed to him that the chief object of the Act was to destroy the effective organisation of trade, which had been such an asset to this country, without any compensating advantage. If collective price maintenance in the labour field represented a desirable practice, how could it be argued that collective price maintenance in

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respect of identical articles produced by different manufacturers was against the public interest ? He hoped that manufacturers would take the active steps permitted by the Act to ensure a standard price for a given commodity.

There should be a determined effort to eliminate trading abuses. The trade discount should be reserved for the trade, and the user, as distinct from the electrical contractor and retailer, should benefit only by a commercially assessed discount based on the quantity he purchased.

In a reference to the National Inspection Council for Electrical Installation Contracting, the President said that its object of ensuring that only contractors qualifying for admission should undertake installation work could only be achieved by intense publicity efforts. In his view the Council could only justify the time, effort and expense involved by ensuring that the public got safe electrical installations.

Commenting on the new Electricity Bill, Mr. Milton said that the industry should welcome any step based upon sound economic principles by which the efficiency of electricity supply could be increased. We must win and maintain the confidence of the public in the usefulness, economy and reliability of electrical appliances. There was room for considerable and sustained education.

This led Mr. Milton to consider the position of the Electrical Development Association which had served an extremely useful purpose. The Association, since 1926, had been exclusively an electricity supply organisation and the President asked whether it should not now be re-organised and again represent all sections of the industry as a publicity organisation which could operate on a more extensive basis.

He also wondered whether the industry could not present to the public an annual demonstration of the services which it offered. The Power Convention exhibition was confined to the venue of the Convention and so was seen by few members of the public and the Electrical Engineers' Exhibition was for the technical man. Would it not be worth while for the whole electrical industry to co-operate in staging a public exhibition commensurate with the industry's importance instead of dissipating its efforts in a host of public exhibitions.

He expressed his personal appreciation of the co-operation of other organisations in the industry and welcomed the increasing mutual understanding between the Electricity Boards and the Association. He advocated that the Area Co-operation Committees established throughout the country should be even more effective than they had been in the past.

The President said that there was a need for a general forum for the industry and pointed to the Fair Trading Council as a possible basis. It only lacked electricity supply representation and could easily broaden the nature of its deliberations to enable a more general discussion to take place.

After a word of appreciation of the friendship of the manufacturers and of the work of the Association's Technical Committee, Mr. Milton referred to the new I.E.E. requirements for earth loop testing. He said that the supply authorities realised their responsibility to provide a metallic earth return path and some allowed the use of their cable sheaths for the purpose. But a complete test could not be carried out on a new installation until the supply mains were connected. Could not the supply authorities declare a maximum value of the resistance of their cable sheaths to the

1.—Registration Office: Miss Stirling hands Mr. F. M. Butterfield his envelope. 2.—Mr. and Mrs. J. Jas. Peters. 3.—Messrs. R. Wilkinson and D. J. Hastings. 4.—Messrs. P. G. and R. L. Lowe and their ladies. 5.—Mr. R. L. Booth, Mr. and Mrs. W. J. Creemer and Mr. J. L. Beynon

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system earthing point so that complete information was available at the design stage of the installation ? Mr. Milton acknowledged the great service rendered to the contracting industry by the I.E.E. Regulations.

The Association claimed that it effectively served the interests of electrical contractors and retailers throughout the country and endeavoured to justify fully the members' pride in their Association. In this connection he thanked the section and branch chairmen and secretaries, the three vice-presidents (Messrs. H. S. Wathes, C. C. Hyams and V. J. Stock), Mr. J. G. Briggs, chairman of the Executive Committee, Mr. L. C. Penwill, the director and secretary, Mr. K. C. Lawley, assistant secretary, and the Association's staff.

Mr. Milton concluded by stressing the importance of everybody, in whatever section of the industry, becoming a member of his appropriate association and playing a full part in its activities.

After a brief interval the delegates reassembled to hear Mr. Stock present the conference paper.

1.—*Messrs. H. Kronheim and G. Taylor.* 2.—*Mr. and Mrs. J. A. Richardson.* 3.—*Mr. and Mrs. G. A. Cooper and Mr. and Mrs. J. Timmins.* 4.—*Mr. and Mrs. W. J. Bird with Mrs. D. L. Tabraham and Mr. Ivor Williams.* 5.—*Mrs. R. Naisbitt, Mrs. J. M. Selsby and Mr. and Mrs. R. W. F. Brown*

Science or Guesswork ?

INTRODUCING his paper " Electrical Contracting—Science or Guesswork ? " Mr. V. J. Stock (Berkeley Electrical Engineering Co., Ltd.), said that it was one of the most curious facts of the electrical contracting trade that nearly all new businesses were started by practical men without any real commercial experience. Any intelligent foreman or chargehand could start on his own and achieve a modicum of success but when this encouraged him to expand, without training or experience, the results were unfortunate.

Estimating, prime cost and stock were matters which the contractor must handle himself and not leave to professional accountants. Commercial security was essential ; it was foolish to put some of the cost of a job which looked " unhealthy " on to another job.

Estimating fell into two classes — existing buildings and new construction and the former was by far the more difficult. Whatever the building, the operation of installation was the same ; it was the type of wall, floor or ceiling which was the important thing. It was essential to envisage the job to be done and then break down the estimate into operational parts so that nothing was omitted and to make future reference easy.

The practical man was likely to be absolutely accurate in assessing the time necessary for a particular job but forgot that this was not so important as the time wasted. In estimating labour costs a mean had to be found between fast and slow workers and from experience a formula could be found to cover all contingencies. Special attention should be paid to pricing the fixing or erection and connection of equipment other than the bulk items of the actual wiring installation.

Materials should be measured accurately. It was impossible to cut the quantity required, only the quality. The lowest possible prices should be included in the estimate but they should be actual prices.

All costs directly attributable to a job should be charged as job overheads and it should be remembered that in the smallest of jobs there was a certain amount of unproductive time in marking out, discussion with other trades and many other interruptions. Travelling time, fares, supervisory visits, insurance, holidays with pay, and delivery of materials from the shop were all job overheads. It then remained to add the final percentage for general overheads.

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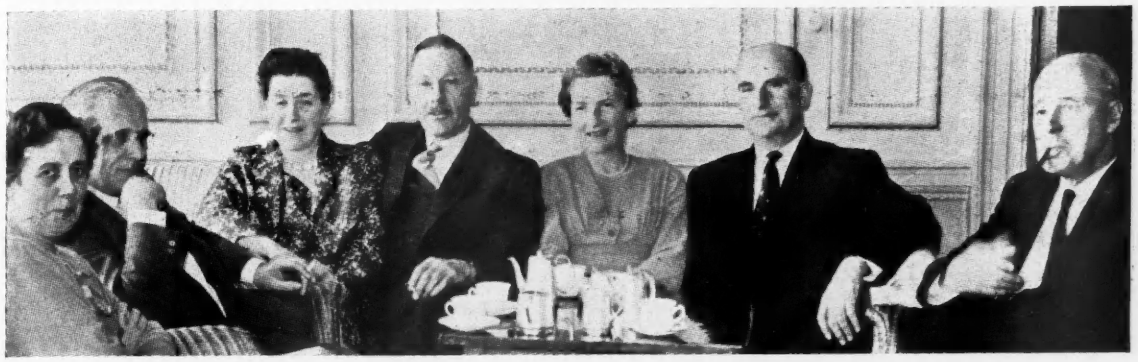

Mrs. P. G. Wallis, Mr. and Mrs. C. C. Hyams, Mr. and Mrs. A. F. Plummer, Mr. E. S. Evans and Mr. P. G. Wallis.

Mr. Stock then turned to the subject of prime cost and advised the use of a loose-leaf prime cost book in which should be inserted sheets giving full details of each job for possible future reference. As full a description as possible should be given of all materials. Costs should be kept up-to-date week by week and compared with the estimate to ascertain whether the job was paying or not. Any downward drift could only be stopped during the course of a contract, not at the end of it.

With a full and accurate prime cost it was possible to prepare an accurate final account by simply comparing it with the estimate and abstracting everything in excess of the estimate. Finally the prime cost book might be useful for reference where an unusual kind of job cropped up again at a later date.

One of the greatest difficulties in electrical contracting was the vast variety of items of materials in daily use and the smaller contractor was tempted to have some of everything The author admitted that it was not easy to decide how much to purchase for stock and pointed out that it was not always economical to purchase materials from a wholesaler as required.

By a careful study of the past it was possible to decide what items should be held in stock and by accurate estimating and planning ahead the materials for any given job could be available in the stores at the right time. Actual lengths of cable needed should be cut, instead of sending full coils to the job. The smaller contractor should confine himself to certain types and makes of accessories, and switchgear should be kept to the absolute minimum or not stocked at all. It was not necessary to stock a large quantity of conduit and conduit fittings ; large quantities for any job should be sent direct by the supplier.

The medium or large contractor was faced with even more problems than the small one for there was a continual flow of odds and ends back to the stores. In many cases unwanted material could be sent back to the supplier and credited. Credits for returned materials should be limited because much of those materials would eventually have to be written off or devalued.

Mr. Stock said that it was too often assumed by clients that having placed a contract they were entitled to ignore the specification and tender except to obtain credits for omissions. Only by close supervision could a contractor tell whether he was doing more than he undertook to do in his tender. Every endeavour must be made to save on the estimate without detriment to the quality or technical efficiency of the job. This could be done by careful planning in conjunction with the chargehand. It was particularly desirable to reduce labour costs—even at the cost of increasing the materials. Supervision was properly the chargehand's responsibility. The engineer's task was to run the job by directing labour through the chargehand, ensuring that the work was being done as he planned it and seeing that the materials were available as required.

The art of engineering a job was to see that only sufficient materials were on site to ensure that the men were never waiting and to see that those materials were paid for in full each time a certificate was issued.

Mr. Stock reading his paper

On small works the engineer need pay only one visit; the right time was when the electrician had his materials on site and had made himself familiar with the layout. In the case of an existing building involving a fairly large installation it was often impossible to assess the value of the work done without frequent visits to the site.

Mr. Stock concluded by suggesting that the ability of the contracting engineer to dissect each problem and to reduce it to its simplest form enabled him to deal with things of which he had never heard and even to advise those with far greater knowledge of the subject.

Discussion

Opening the discussion which followed, Mr. S. L. M. Barlow said that the paper answered logically and sensibly many questions which cropped up from day to day and if Mr. Stock's advice was followed the general standard of the industry would be raised. Mr. Barlow thought that in these days of mechanisation a percentage should be added for wear and tear of plant. Contractors were too prone to look to extras to make up losses.

Mr. H. F. Truman said that every contractor should use the terms and conditions of contract. He adopted the reverse of Mr. Stock's method in that he finished with the intake of supply. He thought it wrong to order small quantities of materials.

Mr. J. Mortimer Hawkins considered that redundant

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Speakers in the discussion on Mr. Stock's paper: Messrs. S. L. M. Barlow, H. F. Truman, J. Mortimer Hawkins, A. S. Redvers Pratt, F. W. Blanshard, C. J. Veness and R. A. Joseph

material from a job due to a customer's change of mind had no value in the stores and should be charged for. He deprecated the practice of subtracting a percentage from the true cost of a tender in the hope that it could be recovered in extras.

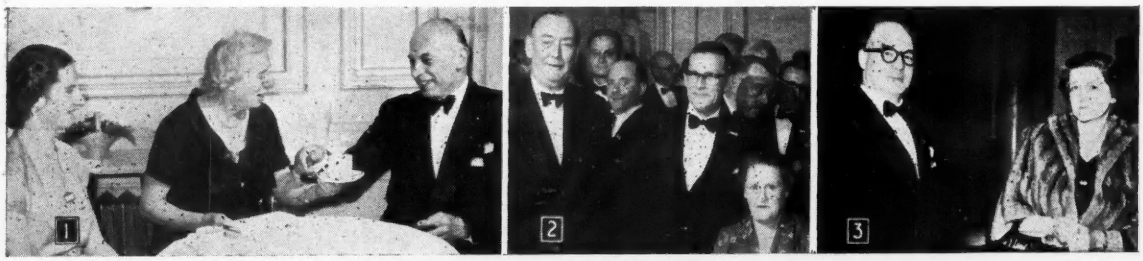
Mr. A. S. Redvers Pratt said that there was too much human element in contracting to allow it to be an exact science. He regarded contracting as the art of providing better living.

Mr. F. W. Blanshard could not agree that the fastest man worked only four days out of eight. The majority of electricians did a good day's work. He mentioned that he found it advantageous to buy cable in 200 and 250 yard lengths, and occasionally extending beyond those limits where necessary.

Mr. C. J. Veness thought that there had been too much " guesstimating " when accuracy was essential. The Association should try to close the loopholes provided by loose specifications. He advocated the addition of a specified percentage in respect of holidays with pay and sickness payments. Responsible contractors carried respectable stocks—not just odds and ends left over. Returned materials were often reduced in value and a percentage of their value should be deducted.

Mr. R. A. Joseph maintained that van mileage should be charged to specific jobs. He asked whether large contracts should not carry a lower rate of overhead than small ones.

Replying to the questions raised, Mr. Stock said that mechanisation called for greater accuracy in estimating; but not all forms of mechanisation were economic. He did not agree with working " backwards " towards the supply intake as it might result in many items being overlooked. He wished to make it clear that when he referred to four hours' work in an eight-hour day he was emphasising the unavoidable loss of time in incidental matters. Nothing should be sent to a site



1.—Mr. J. O. Knowles with his wife and daughter. 2.—At the "Get Together": Brig. W. G. S. Thompson on left. 3.—Mr. and Mrs. H. F. Truman

At Monday's garden party: 1.—Mr. and Mrs. Milton, Mr. L. C. Penwill, the Chairman of the Llandudno U.D.C. (Councillor C. R. Payne) and Mrs. Payne. 2.—Mr. and Mrs. J. Krimholtz and Mr. and Mrs. S. Morley. 3.—Mr. and Mrs. W. Boys and Mr. and Mrs. T. L. Latimer. 4.—Mr. L. J. Mason, Mrs. J. Scott, Mr. S. A. Ponton, Mr. J. Scott, Mr. and Mrs. N. H. Sheppard and Mr. P. Smailes.

Electrical Contractors' Association Conference, Llandudno

The panel at the "Any Answers Please" Session: Messrs. C. C. Hyams, H. S. Wathes, A. V. Milton, L. C. Penwill, J. G. Briggs and V. J. Stock

to lie about for weeks ; the ideal was to supply only sufficient to keep the men fully at work. Special material should not be credited on return to stores. Accurate costing would do away with the gambling on extras. Whether overhead percentages should be varied depended on the job; small ones were costly.

On Monday afternoon delegates climbed (largely by car) the steep height of the Great Orme for the customary garden party at Happy Valley.

The President and Mrs. Milton, who were supported by the Chairman of the U.D.C. and Mrs. Payne, presided at a dance at the Winter Gardens Ballroom in the evening.

Tuesday morning was devoted to the annual general meeting at the Pier Pavilion and after luncheon there was an " Any Answers Please " session. Upon this occasion the " panel " provided the questions and delegates replied from the body of the hall.

The panel consisted of Messrs. A. V. Milton (chairman), C. C. Hyams, H. S. Wathes, J. G. Briggs, V. J. Stock and L. C. Penwill.

One question dealing with participation of manufacturers in the operation of the National Inspection Council (which had rejected applications from certain electrical contractors) brought an interesting reply from Mr. W. J. Bird. He said that manufacturers were asked if they would refuse to supply electrical contractors in certain circumstances. On the other hand he would like to ask if contractors would refrain from purchasing from manufacturers who would not give the required undertakings. Manufacturers would hate to be so restricted that they would be unable to supply a genuine entrant to the industry who might become an asset in due course.

On the question of discounts, Mr. Bird said it was often thought this was the subject of battle between manufacturer and retailer. It was nothing of the sort. It was as important to the manufacturer that the retailer should be assured of a reasonable profit as it was for the retailer to receive it.

In the light of reports by the Monopolies Commission and the provisions of the Restrictive Trade Practices Act was there any advantage in continuing trade associations ? All speakers were emphatic in asserting that associations had scope for increased usefulness.

Concerning the announcement by the Government of its intention to insist on fixed price tendering for all Government and local authority projects, Mr. Penwill said this was a challenge to manufacturers : were they prepared to stabilise their prices. Speakers expressed themselves in favour of a price standstill for twelve months, or more; it could be a tremendous help in the export field. The big problem was rising wage costs. Until there was a national wage policy, the solution to the problem of inflation would be elusive.

Above: Mr. J. S. Jordan, Mr. S. G. Brown, Mrs. Brown and Mrs. Jordan. Below: Mrs. R. A. Marryat and Mr. and Mrs. A. V. Moon.

Other points in the discussion will be dealt with in our next issue.

In handing over the presidency to Mr. H. S. Wathes at the final meeting of the Conference, Mr. Milton said that the new president had served an admirable apprenticeship for the position. Thanking the members for his appointment, Mr. Wathes said that he would do his best to promote the interests of the Association.

Mr. Milton expressed the Association's thanks to all who had made the Conference so successful, and Councillor Payne made a few graceful remarks.

The final function was a reception and dance on Tuesday evening at the Winter Gardens Ballroom, at the invitation of Councillor and Mrs. Payne.

Electrical Contractors' Association Conference, Llandudno

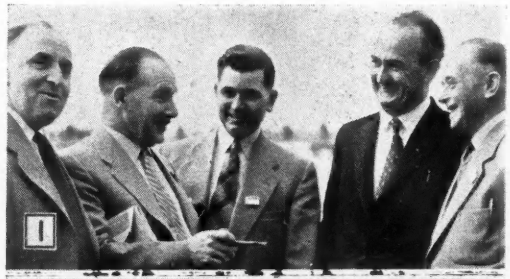
MR. H. S. WATHES

THE NEW PRESIDENT

MR. H. S. Wathes, the new President of the Association, is forty-nine years of age and is the son of a former member of the E.C.A. Council, the late Mr. T. H. Wathes. After his education at Wellingborough Mr. Wathes joined his father's firm T. H. Wathes and Co., Ltd., for training and remained with it until he was mobilised in the Territorial Army in 1939. He received a commission in the Royal Artillery in 1940 and served in A.A. Command until 1944 when he was appointed to the headquarters of the Second Army in Normandy.

In 1945 he resumed his connection with the company and succeeded his father as principal in the following year. He is a member of the Council of the Leicester Chamber of Commerce and became deputy-president in 1956. Continuing family tradition he is a farmer and is a member of the Atherstone Hunt.

Mr. Wathes joined the E.C.A. in 1936 and has served as vice-chairman and chairman of the Leicester Branch, and of the Midlands Sectional Board. He has been a member of the E.C.A. Council since 1949 and of the Executive Committee since 1954 and he is chairman of the Electrical Retailers' National Committee. He was elected a vice-president in 1955.



1.—Messrs. H. B. Davies, E. R. Major, C. K. Manley, E. Evans and J. Ford. 2.—Mr. and Mrs. H. A. Cook with Mr. and Mrs. F. W.Blanshard. 3.—Messrs. W. T. Trace, H. A. Greenfield, T. R. Jones and J. Redfern

1.—The President with Messrs. S. L. M. Barlow and E. A. Reynolds 2.—Mr. C. H. Blackburn, Mr. and Mrs. A. B. Wildsmith and Mr. and Mrs. A. H. Carmichael. 3.—Messrs. R. A. Marryat and V. J Stock. 4.—Messrs. W. J. Jones, J. G. Christopher, T. S. Jones and C. J. W. Scott. 5.—Dr. H. H. Ballin and Mr. F. Roberts.

INDUSTRY AND THE HOUSE

Electricity Bill in the Lords

By A. M. F. PALMER, A.M.I.E.E., M.Inst.F., M.P.

MY last contribution to these columns was made some little time ago because I have been abroad in Italy seeing, among other things, something of the Republic's industrial progress since the war. My general impression, gained in a few fleeting days, was that the best Italian technology is well up to the level of anything that we are doing here in the United Kingdom.

However, a day or so before I went to Italy the House of Commons gave a second reading to the Finance Bill which in the parliamentary sense carries into effect the Chancellor of the Exchequer's annual budget. Mr. Enoch Powell, the Financial Secretary to the Treasury, in moving the Bill went into vast and complicated detail with the result I am afraid that the chamber emptied much too quickly. Honourable Members on both sides found they had other duties in other places.

Taxation and Overseas Trading

Those who remained to listen heard the Minister explain how British companies engaged in industrial affairs abroad were now to be freed from the handicap of having to pay United Kingdom profits and income tax on the profits of their enterprises which they ploughed back or retained as reserves. The object, said Mr. Powell, was not to confer a privilege but to "remove a handicap." Only undistributed trading profits would qualify for exemption for it was not the intention that companies trading overseas should escape tax altogether. A special provision had been included to ensure that a company could not be an overseas trading corporation unless it was liable to pay tax on all its trade somewhere or other in the world. This was, of course, explained the unrelenting Financial Secretary, to assume that there was in every country a tax analogous to income tax in the United Kingdom. At this there was general laughter and a few cries of "Oh" from the Conservative back benches. In a final justification of the change Mr. Powell thought it would mean as the years passed a "broadening flow" of dividends to shareholders in this country to the advantages of the balance of payments.

Mr. Gordon Walker, former Labour Minister who sits for Smethwick, in opening for the Opposition discussed the Government's proposals to give more generous reliefs to the wealthier income tax payer. He seemed anxious to make the point that the Labour Party was not against breaking through what he called "the two-thousand pounds surtax barrier." There had been, and there was, a case for concessions to those above the two thousand a year level. But the Opposition felt that concessions of this kind could only be on condition that they were part of a general tax revision which would help the poorer citizen as well. One grave objection to the benefits to surtax paying shareholders was that these would go to those primarily interested in making money from capital appreciation.

In the general debate that followed a wide variety of opinions were expressed according to the knowledge and taste of honourable Members. Mr. Chapman said the Government were taking a deliberate gamble with the balance of payments while Mr. Pannell could not understand why purchase tax was still retained for commercial vehicles. Mr. Nabarro went further and said the time had come to scrap the purchase tax altogether and substitute for it a turnover tax.

Mr. Douglas Houghton, an Opposition taxation expert, made the Labour winding-up speech. He wanted to know when and how did the Chancellor propose to tackle the "back-log of administrative reform" left over from the report of the Royal Commission on the taxation of profits and income? Could not the Chancellor introduce a tax amendment Bill to contain many of those administrative changes not involving the level of taxation or revenue?

In a lively speech defending his Budget again Mr. Thorneycroft said he could not agree that a tax relief at any level—whether above or below two thousand pounds—was to be regarded as something given away. The State had to impose taxes but when this was done it was right to realise that they were taking away money which belonged to other people. The Chancellor said he had been criticised for being over optimistic in some of his remarks. But he was by nature an optimistic person and the Government was satisfied with the reception which the Finance Bill had received. In his judgment there was little real determination on the part of the Labour Party to throw out the Bill.

Last Monday in the House of Lords, at the committee stage, further attention was given to the Electricity Bill. I could not be present to hear their lordships debate this familiar subject, but I have done the next best thing by reading carefully the debate in Hansard.

Electricity Bill Amendments

Some of the amendments moved on behalf of the Opposition dealt with membership of the Electricity Council and the Electricity Boards. For instance, Lord Lucas wanted all terms and conditions of appointment to conform to "good industrial and commercial standards." He said the nationalised industries were "suffering acutely" because the Government were trying to get the best men into them by paying almost the worst remuneration. Parliament had to see that first-class young men entered the nationalised industries. One of the present faults was that the Boards were often stuffed with "semi-retired nominees."

In answering Lord Lucas the Minister of Power, Lord Mills, expressed sympathy with the view put forward although he thought it would be wrong for any formal provision to be included in the Bill. Industrial and commercial standards varied a great deal between individual firms. Any Minister would find it difficult to know what his true instructions were should the form of words proposed be adopted. Later the Minister promised to think again on the point after Lord Gridley had said they were all impressed by the view that the industry would not stand or fall by structure alone, but would depend on the men who ran it.

An echo of controversies in the Commons was heard when Lord Lucas suggested a new clause to the effect that the Generating Board, the Electricity Council and the Area Boards in the exercise of their functions should have

regard to " the preservation of natural beauty and landscape amenity." For this purpose he wanted the Minister to have greater powers of direction.

In justification of his clause Lord Lucas contended that there had been far too many occasions in the past on which opposition to overhead lines on amenity grounds had been frightened off by the threat that electricity would cost much more with underground lines or that the people in the area might not get a supply at all.

In support Lord Hurcombe pointed out how the new clause was backed by the Council for the Preservation of Rural England. It should be accepted as part of good public policy that in carrying out all works full regard should be had to the preservation of the natural features of the landscape. The cumulative cost of doing this would prove to be little indeed; it would be a reasonable part of the price which those who enjoyed the great benefits of electricity should expect to pay.

In reply Lord Mills said there were practical difficulties about the clause as drafted. He was advised that it might lay the Boards open to serious obstruction or even litigation in carrying forward the power programme. Obviously, there lordships did not think this answer good enough, for the debate continued sufficiently long to induce the Minister to come back to say that he had not rejected the clause but would reconsider the whole matter. We can expect something further at the Report Stage.

As a final fling Lord Lucas moved another new clause dealing with the procedure for applications to erect new power stations and transmission lines. Any Minister, he said, owed it to the public that in circumstances of this kind every opportunity should be given to people to safeguard their rights and that they be given the opportunity before things were cut and dried. A public inquiry should be held by an independent person and final approval not be assumed without an order being laid before Parliament. Lord Mills, however, remarked that the matter must be kept in perspective. Out of the 857 miles of supergrid line already erected, 835 miles had received voluntary agreement. But, once more, he promised to think again.

BOILER-LEVEL CONTROL

A THREE-ELEMENT drum water level control system is now available as an integral part of any automatic boiler control scheme produced by George Kent, Ltd., for water tube boilers. The system is based on existing principles and utilises standard instruments and components.

The three elements taken into consideration by the scheme refer to the three measurements, feed water flow, steam flow and drum water level, all of which are essential for the efficient control of the amount of water in the drum, regardless of the most severe plant fluctuations. The Kent system has the added advantage that it can be readily adjusted on site to match the particular operating characteristics of the boiler plant.

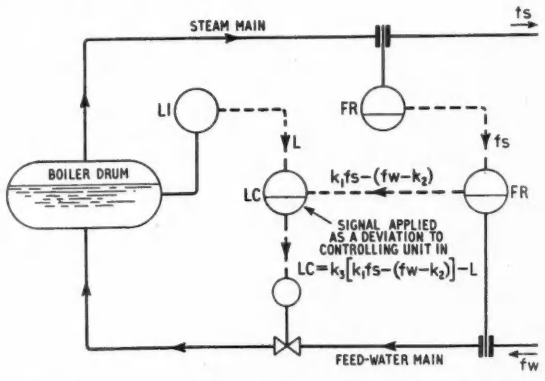
The system makes use of four instruments, a drum level transmitter, a steam flow transmitter, a feed water flow instrument fitted with a computing and transmitting mechanism, and the master instrument of the scheme, a level controller.

The steam flow instrument transmits a pneumatic signal, proportional to the value of steam flow, to the feed water flow instrument. The latter measures the water flow and transmits a signal, which represents the difference between steam flow and water flow, to the master level controller. This controller also receives a signal, proportional to level, from the drum level transmitter.

In the master level controller, the control mechanism operates in response to the difference between the level signal and the steam flow minus water flow signal, and sends a corresponding control signal to the feed water regulating valve. (The system can be regarded as a flow ratio control with desired value set by drum level.)

The system is flexible and can readily be adjusted to match the operating characteristics of the boiler plant. It is possible to set: (a) the amount by which the level changes with a given change of load; (b) the balance between flow-ratio control and level control; and (c) the value of a constant which is introduced into the water flow signal to allow for blow-down.

The drum-level transmitter measures the level by the differential pressure method and is a mercurial U-tube instrument. A special design of detecting element, which is claimed to be an improvement on any used in the past, eliminates errors due to thermal gradients within the pressure pipes. An air-operated transmitting unit is incorporated in the instrument and provides a means of making allowance for the steam density under boiler-operating conditions.



Kent three-element scheme with control connections and signals

The water and steam flow instruments are also of the mercurial U-tube differential pressure type and incorporate air-operating transmitting and computing units of the Mark 20 range.

Royal Society Conversazione

A NUMBER of exhibits of scientific interest were on show at the exhibition held at Burlington House, London, on 23rd May, in conjunction with the conversazione of the Royal Society.

Mr. J. B. Warman and Mr. D. M. Bibb of the Research Laboratory, Siemens-Ediswan, Ltd., had a display demonstrating the use of transistor circuits in conjunction with multi-cathode gas-filled counter valves for counting and storing as applied to an elementary telephone exchange register. The Computer Department of Ferranti, Ltd., explained the principle of electronic computation with examples of number representation, storage and transmission in an electronic digital computer.

In the nuclear field there was a display illustrating some current work at the University of Reading and at the Atomic Energy Research Establishment, Harwell, on the effects of nuclear radiation on the properties of solids.

VIEWS on the NEWS

By REFLECTOR

SOME notes received from the Eastern Electricity Board in connection with the recent opening of a new substation at Sudbury, Suffolk, tell of the vicissitudes of electricity supply in the town in the early days. The first steps to provide a supply were taken by East Anglian Electricity, Ltd., in 1919 when it announced that it was prepared to give a supply if the people of the town would find £4,000, to which the company itself would add £1,000. The account proceeds

> "In 1920 a 600 h.p. diesel engine, together with electrical equipment which had been taken from the captured German submarine U.B.67 was bought. It was hoped that this engine would meet the needs of the company for some years to come but it was found difficult and expensive to convert the machine and the proposal had to be abandoned. Eventually a high speed marine engine, taken this time from a submarine chaser which had previously been submerged in Felixstowe Dock, was purchased and was converted to operate with producer gas and to drive the generator from the U-boat. This machinery proved extremely unreliable and the engine man, a Mr. Shaw, had to sleep in the generating station, or attempt to sleep, because of the numerous breakdowns. The system was quickly loaded to capacity and it was necessary to send a runner round to all the power users at certain times of the day asking them to switch off their motors. The marine engine was superseded by a steam traction engine bought from a well-known threshing contractor, Mr. Jack Bloomfield, a hole being knocked through the wall of the building at the generating station to allow it to drive another generator on a belt; in turn a new German steam engine was purchased to drive a generator with a total capacity of 130 kW."

* * *

The *Western Gazette* reports that the Salisbury and Andover branches of the Electrical Trades Union recently passed a resolution requesting the National Executive of the E.T.U. to call a 24-hour strike on the working day following the nuclear bomb explosions on Christmas Island as a protest against "an immoral experiment." Whatever may be thought about the morality of the tests, the disruption of so much of the nation's life as a protest seems to be irresponsible, if not "immoral." I am glad to see that the request was ignored by the Union's leaders. It has always seemed to me that the use of the strike for non-industrial purposes (so frequent in some countries) is a peculiarly odd way of bringing pressure to bear on Governments.

* * *

One of the "Commercial" television programmes I always make a point of watching is "Members' Mail." This is by way of being a series of success stories showing various ways in which Members of Parliament have helped to solve their constituents' problems. It must, I am sure, prove enlightening to those who think that M.P.s' duties are confined to taking part in Commons' debates. Last week Mr. A. M. F. Palmer, A.M.I.E.E., who will be well known to readers of this journal, appeared in a programme which dealt not with electricity but with water supply. Though his constituency, Cleveland, is to-day largely industrial, conditions in the hill villages are still primitive and many of the tenants rely on pumps for their water supply. Mr. Palmer told of the representations he had received from many quarters, of his discussions with local authorities, and of his "pretty heavy correspondence" with the Minister of Housing and Local Government. Finally he raised the issue in an adjournment debate. The practical outcome of these efforts will be seen next November when water from a large new reservoir constructed by the Cleveland Water Company is piped to the area. Eventually 42,000 people will be served.

* * *

A year or two ago there were reports of experiments by two young Australian surgeons in the use of electricity for anæsthetic purposes. Something of the same nature is apparently being tried out by the Russians. The Moscow correspondent of *The Times* says that a machine is now being produced which is said to be capable of inducing sleep electrically. It was explained to him that the method was being used in cases of insomnia, high blood pressure and ulcers. A rubber helmet is placed over the patient's head with electrodes which are applied to the back of the head and the eye sockets. Sleep is induced by rhythmic electrical impulses passing through the cerebral cortex, causing inhibition in the cells. The "depth" of sleep is indicated by meters; the deeper the slumber the less the resistance of the tissue to the current, it was said.

* * *

Qualified men frequently complain nowadays of the inadequacy of the pay offered to them, but things were much worse fifty years ago, even if the story of a correspondent to the *Electrical Review* of 31st May, 1907, was exceptional. This man answered an advertisement for an "electrician" to take charge of an electrical plant on a gentleman's estate. He was called for an interview and was adjudged satisfactory whereupon he tackled the question of salary.

> "This opened a new feature in the proceedings when my friend went on to say that, owing to the fact that the engine would not require to be run every day, there were some other duties that he would require of me. . . . Among others, he named the following:—Pump water to the house, saw wood, carry messages, telegrams, etc., act as private secretary or factor, trap game, do shooting, beat carpets, repair gates, etc., and then to sum up I was actually offered the magnificent salary of 21s per week!"

The correspondent suggested that this was why the "gentleman" got men who caused him constant and heavy plant renewal expenses.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Sir Sven. W. Hansen, Bt., M.B.E., and **Lady E. A. Hansen** have retired from the board of Marco Refrigerators, Ltd., having disposed of their controlling share interest in the company. **Mr. J. R. Fulford** has also retired from the board. The chairman, Mr. E. G. Batt, and the remaining executive directors, Mr. R. J. Simpson, Mr. E. A. Leach and certain of their friends, have acquired the above holdings. It is not proposed, for the time being, to nominate any new directors in the place of those retiring.

Mr. H. A. Lewis, M.B.E., T.D., B.Sc. (Eng.), A.C.G.I., M.I.E.E., A.M.I.I.A., has been appointed managing director of E.M.I. Sales & Service, Ltd., in succession to the late Mr. E. J. Emery. As from 1st June Mr. Lewis will in addition operate as commercial director of E.M.I. Electronics, Ltd. Mr. Lewis became personal assistant to Mr. Emery in July, 1956, and was appointed a director of E.M.I. Sales & Service, Ltd., last December.

Following his recent reappointment to the board of the British Thomson-Houston Co., Ltd., on relinquishing his offices of comptroller and secretary, **Mr. E. S. Little,** Companion I.E.E., F.I.A.C., has now been elected a director of the B.T.H. Export Co. **Mr. A. E. Wilson,** secretary of the B.T.H. Co., has also been appointed secretary of the B.T.H. Export Co. **Mr. H. G. McHaffie,** B.Sc., A.M.I.E.E., has been appointed managing director of the British Thomson-Houston Co. (Canada), Ltd. Biographical notes and portraits of Mr. Little and Mr. Wilson were published in our issue of 15th February last. Mr. McHaffie went to Canada, as B.T.H. Export Co. representative, in 1950 and became a director and general manager of the B.T.H., Rugby, as a student apprencompany was formed in 1955 under the chairmanship of Mr. E. H. Ball to handle sales and service of B.T.H. products in Canada.

Mr. H. G. McHaffie

After graduating at Edinburgh University, Mr. McHaffie joined B.T.H., Rugby, as a student apprentice and in 1928 was awarded a B.T.H. Fellowship which entitled him to spend a year in the U.S.A. On his return to England in 1929 he spent a short time in the Contract Department before going to A.E.I. (India), Ltd., where he spent three years. From 1934 to 1940 he was with the company's London District Office and then transferred to Rugby where he was engaged on special wartime duties. In 1945 Mr. McHaffie was appointed assistant to the chairman of A.E.I. (India), Ltd., and later was assistant to the chairman of A.E.I., Ltd. He rejoined the B.T.H. Export Co. in 1950.

Mr. L. E. Fraser, sales manager of Bulpitt & Sons, Ltd., is retiring on account of ill-health and is going to live at Rustington, Sussex. He joined the company in 1934 to take over the sales promotion of its "Swan Brand" range of domestic electrical appliances. He has been a member of various B.E.A.M.A. and A.M.D.E.A. committees.

Mr. L. E. Fraser

Mr. Robert Johnson, M.I.Mar.E., M.Inst.F., at present superintendent at Yoker power station, has been appointed by the South of Scotland Electricity Board as superintendent at Clyde's Mill power station. Mr. Johnson is a vice-president of the Electrical Power Engineers' Association and is a member of the Higher Executive and Managerial Grades Joint Committee and the National Joint Board.

Mr. R. H. Rawll, M.I.Mech.E., M.I.E.E., formerly commercial officer, Northern Sub-Area, London Electricity Board, took up on 1st May the appointment of manager of the newly-created district comprising Hackney, Islington and Stoke Newington, which forms part of the Board's scheme of reorganisation.

Mr. R. H. Rawll

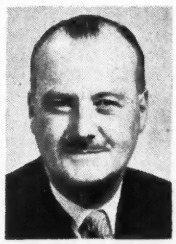
He was educated at the Grocers' Company's School, London, and received his technical training at the Hackney Technical Engineering Institute. After a period with Dick, Kerr & Co., Ltd., he served in the 1914-18 war with the London Electrical Engineers, the R.F.C., and as a navigation officer with the R.A.F. Following two years as a pupil in the electrical department of the L. & N.W. Railway, he joined the City of Birmingham Electric Supply Department in 1922 as a junior engineer and held successive appointments with that undertaking, including frequency change engineer and sales and development engineer. In 1946 he was appointed borough electrical engineer and manager at Shoreditch, occupying this position until vesting day.

Mr. Rawll is a past chairman and hon. secretary of the I.E.E. South Midland Centre and past chairman of the I.E.E. Utilisation Section, and has served on various E.D.A., E.R.A., and B.S.I. committees. He is a freeman of the City of London.

Mr. Paul N. Matton, managing director of Trico-Folberth, Ltd., has been elected to the Council of the Institute of Export.

Mr. Leslie Gamage, vice-chairman and joint managing director of the General Electric Co., Ltd., has been re-elected president of the Institute of Export for the fifteenth consecutive year.

Mr. M. H. Hammill, B.Sc., A.M.I.Mech.E., who has been director and general manager of Foster Transformers, Ltd., South Wimbledon, S.W.19, since 1950, has been appointed managing director. Before joining the company, which is one of the Lancashire Dynamo group, he was associated for many years with the industrial consultants, Urwick Orr & Partners.



Mr. M. H. Hammill

Mr. J. Gourlay and **Major-General G. L. Watkinson,** directors of Stothert & Pitt, Ltd., have been appointed joint managing directors. **Mr. A. V. Kennedy,** who has been acting managing director pending the new appointments, will continue in office as an executive director.

Seventy years ago Mr. Austin Walters, an electrical engineer, commenced business on his own account as a manufacturer of electrically illuminated signs, and later was joined by his son, **Mr. Wallace Walters,** as an assistant. Recently, Mr. Wallace Walters, now managing director of Austin Walters & Son, Ltd., celebrated his diamond jubilee in business life and was presented with a gold wristlet watch, the gift of the staff, at a

Mr. N. Whittle (left) making a presentation to Mr. W. Walters to mark his diamond jubilee with Austin Walters & Son, Ltd.

ceremony in the company's head office at Ayres Road, Old Trafford. The presentation was made by Mr. N. Whittle, contracts engineer (with thirty-seven years' service) on behalf of the staff, who paid tribute to the happy relations which had always existed in the company, and Mr. Walters, who was leaving for a fortnight's stay in Majorca, suitably replied. In addition to illuminated signs and neon lighting, the company now makes transformers and heavy storage racking.

At the invitation of the directors of **Hepworth & Grandage, Ltd.,** nearly 4,000 employees and guests spent the day in Blackpool on 18th May. This outing was part of the celebrations in connection with the company's golden jubilee.

Mr. John Boyle, editor of the South Eastern Electricity Board magazine, *SeaBoard*, is the new chairman of the National Executive of the British Association of Industrial Editors. Mr. Boyle was elected at the Association's 1957 Convention held at Harrogate and for the past year has been vice-chairman. He is the first member from a nationalised industry to hold the office.

Mr. J. Boyle

The Association's northern region has elected **Mr. S. Robinson,** editor of *Areatopics*, staff magazine of the North Western Electricity Board, as its chairman for the coming year.

Mr. Isaac Sclar, M.I.E.E., has been elected president of the Electrical Contractors' Association of Scotland in succession to Mr. David G. Lindsay, A.M.I.E.E. Mr. Sclar is chairman and managing director of James Scott & Co. (Electrical Engineers), Ltd., and has taken a prominent part in Association affairs for many years. He has been chairman of the Edinburgh and East of Scotland Branch, chairman of the Joint Apprenticeship Council and vice-president.

Mr. Sclar commenced his business training in 1918 in the Dunfermline branch of James Scott & Co. Earlier he was a lecturer in electrical engineering in Fife Technical College. He is a founder member of the I.E.E. Scottish Students' Section, a past-chairman of the Dundee Sub-Centre of the I.E.E. and a founder member and past president of the Edinburgh Electrical Society.

In our issue of 17th May we reported that **Mr. F. Williams** had been appointed manager of the Bristol branch of Johnson & Phillips, Ltd., in succession to **Mr. A. F. Herbert,** who has become manager of the company's Manchester branch, following the retirement of Sir Herbert Barber. We now reproduce Mr. Williams' portrait.

Mr. F. Williams

Mr. Horace White, C.B.E., has been appointed group public relations officer to Metal Industries, Ltd. He takes up his new post in mid-June.

The annual general meeting of the **Ipswich and District Electrical Association** was held at Electric House, Ipswich, on 20th May. The secretary reported that the Association continued to grow, membership being increased this year by some twenty members. The following officers were elected : — President: Mr. C. T. Melling, C.B.E. (chairman, Eastern Electricity Board). Vice-president: Mr. H. P. Thompson (Flinders (Wholesale), Ltd., Ipswich). Chairman: Mr. R. A. Jackson (manager, Eastern Electricity Board, Ipswich District). Vice-chairman: Mr. A. White (manager, General Electric Co., Ltd., Ipswich). Hon. secretary: Mr. W. Rowberry (Siemens-Ediswan, Ltd., Ipswich). Hon treasurer: Mr. W. H. Howell (Eastern Electricity Board, Ipswich). Hon. press relations officer: Mr. H. H. Wright (Metropolitan-Vickers Electrical Co., Ltd., Ipswich).

Mr. O. G. Cook, A.M.I.E.E., retired on 24th May from the position of district manager, Keighley District of the Yorkshire Electricity Board.

Mr. Cook served his articles with the borough electrical engineer, Morecambe, and continued there until he became a shift engineer at Lancaster. He then went to the British Westinghouse Co. at Manchester, and was in charge for some years of the Ripon Command military power station. He was subsequently engineer and manager to the Barnoldswick Urban District Council and chief engineer and manager to the Bingley Urban District Council and he was appointed at vesting day as district manager of the Keighley District. He was chairman of the Mid-East England Centre of the I.M.E.A., and acted for many years as hon. secretary of the Committee of Small Municipal Electricity Authorities throughout Yorkshire and the North East Coast. Mr. Cook informs us that while he is retiring from the service of the Yorkshire Electricity Board, he will be continuing his activities in other directions.

Mr. O. G. Cook

Mr. L. J. Archer, A.R.C.Sc.I., who writes in this issue on " Overhead Line Performance " (page 991) studied engineering at the Royal College of Science of Ireland and was one of the last students to obtain its associateship in 1926 before the R.C.S. was absorbed

[Photo: East Anglian Daily Times

Mr. R. A. Jackson, the new chairman of the Ipswich and District Electrical Association, receiving the chain of office, showing (left to right): Mr. H. P. Thompson, Mr. A. White, Mr. Jackson, Mr. W. H. Howell and Mr. W. F. Rowberry

in University College, Dublin. After a brief period with Siemens-Schuckert on the Shannon scheme he entered the Contract Department of British Insulated Callender's Cables, Ltd., at Prescot. He spent three years in Brazil on a railway electrification contract and on returning to this country was put in charge of the Sheffield office during electrification of the Sheffield-Wath Railway. In 1946 Mr. Archer obtained an appointment with the Electricity Supply Board in Dublin and in 1949 he was appointed to his present position as senior assistant engineer (transmission) with the Merseyside and North Wales Electricity Board.

OBITUARY

Mr. Eric Rosewarne Fry, M.I.E.E., M.I.C.E., Associate I.N.A., deputy chairman of Brooke Marine, Ltd., Lowestoft, died in a Norwich nursing home on 12th May, at the age of sixty-two. Mr. Fry, who was a native of Lowestoft, was trained as an electrical engineer and after leaving training college he was apprenticed to the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester. Later he joined the Foundation Co., Ltd., and erected for it some of the first high voltage transmission power lines in the United Kingdom. In 1929 he erected the first steel power line carrying spans of over a mile. Mr. Fry joined Balfour, Beatty & Co. as construction superintendent for the whole of the north-west grid system in the early 1930s, and just before the outbreak of the last war he was C.R.E. with the War Department on construction work in Southern England. When the Dowsett group acquired the Brooke Marine shipyard at Oulton Broad in 1941, Mr. Fry was appointed general manager and soon afterwards became managing director.

The late Mr. E. R. Fry

Mr. F. H. Whysall.—The death occurred in hospital in Belfast on 23rd May of Mr. F. H. Whysall, M.I.E.E., who was city electrical engineer and general manager of the Belfast Corporation Electricity Department from 1929 until his retirement in 1941. He was in his eighty-first year.

Mr. Whysall was born at Ripley, Derbyshire, and received his education at the Borough Collegiate School, Rotherham, and Sheffield Technical School, and his practical training with the Midland Iron Co., Ltd., Rotherham, and the Sheffield Telephone Exchange & Electric Light Co. In 1897 he became charge engineer at the former Sheaf Street power station, Sheffield, and in 1901 was appointed resident engineer, city power stations, Manchester. His next post was as borough electrical engineer of Greenock, which he held from 1914 to 1927, when he went to Belfast. He was chairman of the Irish Centre of the I.E.E. in 1930, chairman of the Northern Ireland Sub-Centre of the I.E.E. for 1937-38, and chairman of the Northern Ireland Area Committee of E.D.A. from 1928 to 1937.

WILLS

Mr. J. Southern, managing director of Worthington-Simpson, Ltd., who died on 6th December last, intestate, left £39,762 gross (£37,259 net).

Mr. A. G. N. Dixey, formerly secretary of the Edison Swan Electric Co., Ltd., who died on 25th January last, left £12,859 gross (£12,156 net).

Mr. W. McConnachie, an authority on a.c. motor design, for forty-three years with the British Thomson-Houston Co., Ltd., who died on 2nd December last, intestate, left £9,138 gross (£8,581 net).

Mr. S. B. West, A.M.I.E.E., general manager of the Clayton Equipment Co., Ltd., Derby, who died on 1st December last, left £5,348 gross (£5,154 net).

Mr. N. J. Haddon, accountant of No. 5 Sub-Area (Blackburn), of the North Western Electricity Board, formerly borough treasurer at Bacup, who died on 20th November last, left £7,612 gross (£7,489 net).

Mr. A. M. Foden, chartered electrical engineer, with the Vulcan Boiler and General Insurance Co., for over forty years, who died on 10th November last, left £5,192 gross (£5,128 net).

Mr. W. C. R. Lindley, first assistant district engineer with the South West Fylde District of the North Western Electricity Board, who died on 7th November last, left £3,007 gross (£2,934 net).

Mr. E. S. Hoare, M.C., B.Sc., A.C.G.I., M.I.C.E., A.M.I.E.E., for many years senior partner of Hoare, Lea & Partners, consulting engineers, who died on 14th February last, left £81,233 gross (£66,993 net).

Bowthorpe "Coming-of-Age"

The "coming of age" of the business of Bowthorpe Holdings, Ltd., was celebrated on Friday last when the company held a staff dinner-dance at the Hotel Metropole, Brighton, at which many of the company's customers and suppliers were represented, Mr. J. Bowthorpe (managing director) presiding over a gathering of over 300. The occasion was essentially a festive one and the speeches were in the party spirit. Mr. N. L. Keen (director) set the tempo in proposing the toast to the guests, and in a breezy speech he particularly welcomed the ladies and the representatives of the company's customers. Mr. M. L. Miller, who responded, was in good form, and in a sparkling speech said that Mr. Bowthorpe should be proud in rearing a child, which had proved a prodigy, to maturity.

The main toast of the evening—"The Firm"—was proposed by Mr. R. A. Parsons (works director). He mentioned that he was the company's first employee, starting with Mr. Bowthorpe in a downstair basement in Eagle Street, London, W.C.1, in 1936. From the beginning Mr. Bowthorpe was keen on developing an export trade and as early as 1937 a South African agent was appointed. In 1938 the company moved to Croydon, and two years later larger premises were taken over near Oxford. This move proved a milestone in the company's history and the business developed rapidly during the war.

The move to Crawley was made in 1948. These works had an area of 84,000 sq ft while the works of the group (Bowthorpe Electric Co., Ltd., Bowthorpe Engineering Co., Ltd., Hellermann, Ltd., Cheltenham Plastics, Ltd., Line Equipment, Ltd., and Hellermann (Canada), Ltd.) now occupied a floor area of 124,000 sq ft. From a staff of three, they now employed over 900 people. He said that the company's growth was an outstanding example of achievement and enterprise and its success was due to the foresight of Mr. Bowthorpe.

In responding, Mr. Bowthorpe also referred to the early days of the company and he made presentations to three employees (Messrs. P. Watts, S. E. Downer and P. Morley) who had been with the company from the beginning, and to Mr. Dymock (cashier), who had completed 11 years' service. Mr. Morley, on behalf of the staff, presented Mr. Bowthorpe with a clock to be placed in the company's boardroom.

Following the dinner there was dancing and an excellent cabaret and during the evening a huge birthday cake was wheeled in and was cut by Mrs. W. R. T. Skinner, wife of the deputy chairman of the South Eastern Electricity Board.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £236 10s 0d
Fire Refined 99·70%	ton £235 0s 0d
Fire Refined 99·50%	ton £234 0s 0d
COPPER Tubes	lb 2s 3½d
Sheet	ton —
H.C. wire and strip	ton £287 5s 0d
LEAD, English	ton £96 15s 0d
Foreign	ton £95 0s 0d
MERCURY	flask £88 10s 0d
TIN, block (English)	ton £764 10s 0d
ZINC, G.O.B. Foreign	ton £83 5s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 1s 11½d
Sheet	ton —
Wire	lb 2s 7½d
PHOSPHOR BRONZE Wire	lb 3s 11½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26½d—26¾d

INDUSTRIAL NEWS

Engineering Wages Agreement

Agreement was reached last week between the employers and employees in the engineering industry upon the wage claim which has been under discussion for some months. Increases of 11s a week for skilled men, 10s for semi-skilled and 9s for unskilled are to be paid as from this week and the unions have agreed not to apply for a further increase until 23rd May next year. Women's wages are also to be raised by amounts ranging from 3s 5d to 8s a week.

It is a part of the agreement that the unions will instruct their members to observe existing agreements and settle disputes by the agreed procedure. The unions' executive committees will use their authority and influence to prevent unofficial strikes, overtime embargoes and restrictions on earnings and output, as well as to facilitate the introduction of new machines and techniques.

Attempts to secure a similar settlement in the shipbuilding industry have so far been unsuccessful.

B.I.F. Electrical Exhibitors' Committee

With the drastic reduction in the past few years in the number of electrical concerns participating in the Birmingham Section of the British Industries Fair it was doubtful whether it was necessary to keep the Electrical Exhibitors' Committee in being. As a result of replies to a circular sent by the Committee to exhibitors at the 1955 and 1956 Fairs it has been decided to disband the Committee. It is possible that a similar committee may be set up to look after the interests of the firms showing in the Electrical Engineers' Exhibition.

From its establishment a few years ago the B.I.F. Electrical Exhibitors' Committee was responsible for securing many improvements in the arrangements at Castle Bromwich including the car parks, catering facilities, travel services, heating and ventilation, electricity supply and telephone connections to stands, etc. The Committee was also actively concerned with the preparation and distribution of the E.D.A. Press matter and the *Electrical Review* stand guide. At the request of the majority of the Birmingham exhibitors it helped to negotiate the move of the Electrical Section from Birmingham to London last year.

E.A.W. Northern Conference

The annual general meeting of the North West England, Merseyside and North Wales Area Federation of the Electrical Association for Women was held at Southport on 8th May with an attendance of 350 from Lancashire, Cheshire, Cumberland and North Wales. A civic welcome was given by the Mayor, Councillor F. E. Thornley, J.P., accompanied by the Mayoress, and the speakers were Miss Mary George, M.B.E., director of the E.A.W.; Mr. P. Bregazzi, M.I.E.E., sub-area manager; Mr. T. Coates, M.Eng., M.I.E.E., deputy chairman, North Western Electricity Board; and Mrs. J. C. Christie, area chairman.

Japan to Purchase Reactors

It is reported from Tokio that nine Japanese electricity supply companies have combined to form a nuclear power generation group and purchase two reactors. One of these would be a 140 MW plant of the Calder Hall type from Great Britain and the other a 134 MW pressurised-water enriched-uranium reactor to be obtained from the Yankee Atomic Electric Co. of the United States. It is expected that the orders will be placed before next March.

Australian Tariff Reductions

At Canberra last week the Australian Minister for Trade stated that as from 23rd May the import duties on about 800 items (whose value last year was about £A160 million) would be reduced from 12½ or 17½ per cent to 7½ per cent. Details of the classes of goods affected are not yet available but the Canberra correspondent of *The Times* says that they are mainly in the "materials and manufactures" group and include generators and high voltage cables.

Power Engineers' Salaries

Reporting on the Board of Arbitration appointed to investigate the differences between the Electrical Power Engineers' Association and the Central Electricity Authority and Electricity Boards in the matter of salaries, the *Electrical Power Engineer* says that the chairman (Mr. G. G. Honeyman, C.B.E., Q.C.) indicated that the Board had formed the following conclusions:—(*a*) That the "ceiling" of the salary structure should be raised and (*b*) that the Board did not accept that the Association was entitled to go right back to 1948 in assessing its claim.

The chairman indicated without prejudice a figure which the Board had in mind as the new ceiling of the salary structure and directed the parties to meet and endeavour to frame a new salary schedule in conformity with the broad indication which had been given. The Board would then hold a further meeting to award a schedule, if agreed, or alternatively to deal with the matter if agreement was not reached.

Subsequently the parties met but while it was agreed that the ceiling should be raised to £2,050 the E.P.E.A. was not satisfied that members other than those in the top grades would secure much benefit. A further meeting was held last Friday, at which agreement was reached on the differential claim. It was also agreed that there should be a cost of living award which would raise the maximum salary to £2,100.

Winder for Grimethorpe Colliery

The Metropolitan-Vickers Electrical Co., Ltd., has received an order from the National Coal Board, N.E. Division, for a large electric winder to be installed at Grimethorpe Colliery. The value of the contract is £157,000.

The winder will be of the conventional type with a single cylindrical drum 18ft in diameter and 14ft wide. Geared drive will be by twin d.c. motors with a combined rating of 2,700 h.p. (r.m.s.) which will have automatic Ward-Leonard control on the closed loop Lamex system. The mechanical parts of the winder will be manufactured by Vickers-Armstrongs (Engineers), Ltd., acting as sub-contractors to Metropolitan-Vickers.

Window Display Competition

The national final of the window display competition, organised by British National Electrics, Ltd., for service centres of the Electricity Boards, was held recently, the various area winners being judged for the national prize of £50. The winning display was by the Whitefield Service Centre of the North Western Electricity Board. The judges were Mr.

The window display of the Whitefield Service Centre, North Western Electricity Board, which won the competition organised by British National Electrics, Ltd.

O. Pawsey (*Electrical & Radio Trading*), Mr. N. Phillips (E.D.A.), Mr. H. J. Riches (exhibition designer), Mr. J. Sanders (Sales Department, British National Electrics) and Mr. W. S. Boone (publicity manager, British National Electrics).

Hedge-Cutting Fatality

Faulty wiring is believed to have caused the death of Arthur Parton (45), of Blackpool, who received a fatal shock while using an electrical hedge-cutter in the garden at his home. At the inquest his wife said she could not remember whether her husband was holding the hedge-cutter, but she disconnected the plug. A neighbour applied artificial respiration without success. Mr. T. Bibby, a brother-in-law, described Mr. Parton as quite a good amateur electrician.

Mr. S. Sykes, chief installation inspector, North Western Electricity Board, who examined the equipment, said that in his opinion the cause of the accident was faulty wiring between the mains and the cutter. He agreed with the coroner (Mr. T. Blackhurst) that the wiring was obviously not done by a skilled electrician. The Board recommended that that type of hand-operated portable tool should be used at a much lower voltage, about 110 V, to reduce the risk of dangerous shock.

The coroner, recording a verdict of "Death by misadventure," remarked that in the majority of cases of electrical accidents which he had dealt with the main cause had been faulty wiring by amateurs.

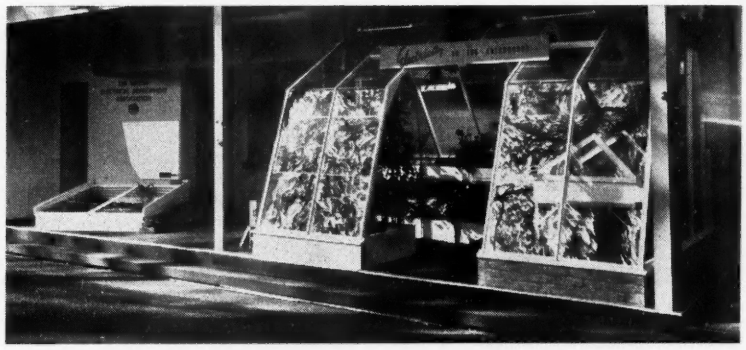
New Marconi Marine Belfast Premises

The new Marconi House, Corporation Square, Belfast, of the Marconi International Marine Communication Co., Ltd., was officially opened by Sir Noel Ashbridge on 14th May. The new premises supersede the old premises in Head Line Dock Building at York Branch Dock, which have housed the Belfast depot since 1927. They include, in addition to office accommodation, a test and repair room, stores and a battery charging and maintenance room.

Pumped Storage Scheme Contract

The Central Electricity Authority has placed with the British Thomson-Houston Co., Ltd., a contract, valued at nearly £1 million, for the design, manufacture, testing and installation of four 75,000 kW, 16 kV generator/motor units for the first major pumped storage scheme in Great Britain and, it is believed, the largest of its kind in the world. This is at Blaenau Ffestiniog in North Wales. The consultants are Messrs. Freeman, Fox & Partners, and Messrs. Kennedy & Donkin.

During peak load periods water will be allowed to flow from the upper reservoir through the turbines more than 900ft below driving the B.T.H. machines as generators. After the water has passed through the turbines it will be stored in the lower reservoir for pumping back to the upper reservoir at times of low demand.



The display of the British Electrical Development Association at the Chelsea Flower Show which was held last week

Transistor Applications

After the conclusion of the annual afternoon and evening courses of lectures on "The Properties and Applications of Transistors," a two-day course on "Large-Signal Switching Applications" was held at the Borough Polytechnic, S.E.1, on 25th and 26th April. Seventeen organisations sent 52 members of their research and development teams and five lecturers gave opening talks which were followed by questions and discussions.

The subjects and speakers were as follows:—"Junction Transistors and Switches," by Mr. C. H. Parks (Siemens-Ediswan Research Laboratory, Blackheath); "Transistors in D.C. Amplifiers," by Dr. G. B. B. Chaplin (A.E.R.E., Harwell); "Properties of Avalanche Transistors," by Dr. R. C. V. Macario (A.E.I. Research Laboratories, Aldermaston); "Transistors in Servo Systems," by Dr. A. G. Milnes (R.A.E., Farnborough); and "Transistor Circuits using Ferrite Cores," by Mr. G. H. Perry (R.R.E., Malvern).

Works Visits

His Excellency Monsieur Emin Kalafat, State Minister of Turkey, who is on an unofficial visit to England, last week toured the Enfield factories of Thorn Electrical Industries, Ltd. The visit was arranged in connection with the plans of Thorn Electrical's Export Division to resume its trading activities with Turkey.

Accompanied by Mr. R. E. Davis, a director of Thorn Electrical Industries, Mr. Kalafat was shown the Ferguson television assembly lines and Atlas fluorescent lamp works and was later shown the work being done on colour television problems at the Sylvania-Thorn Colour Television Laboratories by Mr. Brian Fleming-Williams, research director.

A group of managers of electrical departments of London stores recently visited the new works of Dimplex, Ltd., at Millbrook, Southampton. After luncheon at the Testwood Country Club in the New Forest the party visited the original Dimplex works at Totton before proceeding to the two new factories at Millbrook. Mr. E. J. Wade, managing director, reviewed the several new product developments which the company will be announcing in the coming months and Mr. D. N. Dale, advertising manager, then gave a talk about the advertising and sales promotion plans now being formulated for next winter.

Electrothermal Expansion

Electrothermal Engineering, Ltd., informs us that it has taken over a further manufacturing unit in the Southend area, which gives the company another 10,000 sq ft of space. This additional space is to be used for the Electronic Components Section and Industrial Heating Division.

Profit Sharing Scheme

On 22nd May Horace Green & Co., Ltd., held their 43rd annual meeting and profit sharing in the works canteen, when employees received a share in the profits made by the company during the preceding year. Mr. Horace Green pointed out that the company, which commenced in 1910, started profit sharing in 1914 and had continued to do so each year since.

During the meeting one of the employees was presented with a gold watch in recognition of 40 years' service.

Food Hygiene

On Tuesday last week there was a private showing of a talkiestrip, "The Safety Zone," presented by the Domestic Refrigeration Development Committee, a body whose members are leading manufacturers of domestic electric refrigerators. The talkiestrip shows graphically the dangers of perishable foodstuffs and how a refrigerator will not only ensure better health, but will repay its initial cost by preventing food wastage. It also indicates some of the dishes that can be made with the aid of a refrigerator. The talkiestrip will be sent, free of

charge, to such bodies as Women's Institutes, Young Farmers' Clubs, health and education authorities, and bookings can be made either through the local offices of a Committee member, or through Editorial Services, Ltd., 30-31, Great Queen Street, London, W.C.2. The companies represented on the Committee are Astral Equipment, Ltd., Coldrator (Hotpoint Electric Appliance Co., Ltd.), Electrolux, Ltd., Frigidaire Division, General Motors, Ltd., Kelvinator, Ltd., Prestcold (Pressed Steel Co., Ltd.), English Electric Co., Ltd., and the General Electric Co., Ltd.

Import Duty Exemption

The Treasury has made an Order which continues for a further period of one year from 13th May the current exemption from duty under the Import Duties Act, 1932, of certain forms of nickel and ferro-nickel alloys. The new Order also extends the exemption of duty, for the same period, to nickel in the form of briquettes. Copies of this new Order, the Import Duties (Exemptions) (No. 5) Order, 1957 (S.I. No. 785), may be obtained from H.M. Stationery Office, price 3d.

Electrical Catering Equipment

Electroway Heaters, Ltd., informs us that it is supplying equipment for one of the establishments of Pronto Foods, Ltd., including griddles, griddle grills, salamanders and fryers.

Otley Show

The 150th annual show of the Wharfedale Agricultural Society took place at Otley on 18th May and was attended by the Princess Royal. The Yorkshire Electricity Board's stand, shown in the accompanying photograph, was housed in a 70ft by 30ft marquee which was divided into three sections. An agricultural section showed, by means of E.D.A. models, enlarged photographs, descriptive matter and some equipment, the application of electricity to hay-drying, food preparation, grain-drying, poultry and pig farming, pumping, dairying and potato sprouting. Another section contained a comprehensive display of domestic equipment and, lastly, there was a cookery demonstration theatre seating 40 with standing room for many more. Demonstrations were given at frequent intervals before packed audiences.

Materials Testing Mission

Details of a proposed Mission to study materials testing in the United States have been announced. The purpose of the Mission, which is organised by the European Productivity Agency, is the collection by experts from a number of West European countries of detailed information on the latest techniques and equipment used in American industry for testing and inspecting materials in course of manufacture in the engineering and electrical industries (including tests carried out in the metallurgical industries during the last stages of processing the products of those industries before they reach the engineering and electrical industries). Particular attention will be paid to non-destructive testing methods, but testing to destruction will also be studied. Although the main concentration will be on ferrous and non-ferrous metals, it is hoped that there will be opportunities for studying the testing of plastic materials or chemical products.

The programme in the United States will last five weeks, starting at the beginning of October next, so as to enable members of the Mission who wish to do so to take part in the Second World Metallurgical Congress to be held in Chicago from 2nd to 8th November. The Mission is to be limited to thirty persons and will include experts on laboratory tests and research, experts on the practical application of tests in industry and manufacturers of testing equipment. It will be self-financed, members being responsible for their travelling expenses and the cost of their stay in the United States.

Applications to participate in the Mission must be submitted to E.P.A. by 8th June. Requests for application forms and further information should be sent to the Engineering Industries Division (Branch E.I.D.1(a)), Board of Trade, Horse Guards Avenue, S.W.1 (telephone: Trafalgar 8855, Extension 7507).

The Yorkshire Electricity Board's stand at the Wharfedale Agricultural Society's Show

Purchase of Uranium

The United Kingdom Atomic Energy Authority has offered to purchase uranium-bearing ores from small producers in the Federation of Rhodesia and Nyasaland.

Until 31st March, 1964, the Authority is prepared to purchase, in any one year, suitable ores containing up to 100 tons of uranium oxide, and will accept small consignments containing not less than a quarter ton of oxide.

B.E.A.M.A. Publicity Conference

Following the successful publicity conference held last year the B.E.A.M.A. Publicity Committee is arranging a second conference at the Connaught Rooms, London, W.C.2, on Thursday and Friday, 7th and 8th November. The speakers will include experts from outside the industry as well as members of the electrical manufacturing industry and the subjects will be "Press Advertising at Home and Overseas"; "Editorial Publicity and Press Relations"; "The Compilation of Technical and Sales Literature"; "Printing Techniques"; and "Exhibitions and their Practical Problems."

The "Hobby-Horse" session, in which delegates will have the opportunity of speaking on subjects of their own choice, will also be repeated. Mr. D. G. Denoon, publicity manager (public relations), British Insulated Callender's Cables, Ltd., will be the chairman. Attendance will again be restricted to staffs of B.E.A.M.A. member-firms. An informal dinner will be held for delegates at the Dorchester Hotel on Thursday evening, 7th November.

Trade Announcements

Kolster-Brandes, Ltd., announce the appointment of Mr. H. G. Morgan, of 30, Porthkerry Road, Barry, Glamorganshire (telephone: Barry 1033), as their South Wales and Hereford area representative. He succeeds the late Mr. T. W. Comden.

Work has begun on the extension to the factory of **Hoover, Ltd.,** at High Wycombe, Bucks., to increase its size from its present 62,000 sq ft by the addition of a further 7,200 sq ft of factory space. This is to make room for increasing the production of the Hoover steam-or-dry iron.

The **Lancashire Dynamo Group** sales office in Scotland is now at 5, Woodside Place, Glasgow, C.3 (telephone: Douglas 0867/9).

Mr. Percy Taylor, Taunton (member of the E.C.A.), asks us to state that he is not a director and has no financial interest in the wholesale electrical and radio business being carried on by his son, Mr. C. P. Taylor as Parts, Ltd., Taunton.

WORLD POWER CONFERENCE

SECTIONAL MEETING IN YUGOSLAVIA

IN accordance with a policy of holding sectional meetings during the six-year intervals between plenary meetings (such as that held in Vienna last June), the World Power Conference will assemble next Wednesday in Belgrade, where it will remain in session until 11th June. The theme of the present occasion is "Power as a Factor in the Development of Undeveloped Countries," which seems appropriate in view of the possession by Yugoslavia of natural energy resources that are far from being fully exploited.

Chief among these resources is a large hydro-electric potential of which less than 3 per cent is estimated to have been brought into service. Only a relatively small surplus (less than 60 million kWh in 1955-56), after meeting the growing needs of the country's population of 18 million, is exported, but on the basis of a report drawn up in February, 1955, by the Economic Commission for Europe, an organisation ("Yougelexport") composed of representatives of the electricity supply industries of Austria, the Federal Republic of Germany, Italy and Yugoslavia decided last November to embark on a large-scale scheme of development. The project provides for a capital expenditure of £137 million for the building on Yugoslav territory of four water-power stations and the transmission of their output at 380 kV to adjacent States.

One of these stations is the Zvornik plant on the River Drina, where 92 MW, installed in 1955, now generates over 400 million kWh/annum; it is situated about 100 miles from Belgrade and is scheduled for a visit during the conference, as is also the 64 MW Kolubara thermal station, 30 miles from the city, which produces about 230 million kWh/annum.

The contemporary position as regards electricity supply in Yugoslavia as a whole is that between 1st October, 1955, and 30th September, 1956, the number of kWh generated reached 4,794 million of which 2,958 million was derived from water. This compares with a total of 3,440 million kWh in 1954, of which the hydro figure was 1,810 million.

Next to water, brown coal and lignite constitute the biggest power producing asset; 14 million tons were made available in 1955 out of "proved reserves" of over 7,000 million tons, and "probable reserves" of twice that amount. Little more than a million tons of hard coal was mined from about 21 million tons of proved and 180 million tons of probable reserves.

After the close of the technical session, at which the principal points from 200 or more papers (27 by British authors) are expected to be presented for discussion from among the 53 member nations of the W.P.C., further opportunities will be provided of noting the signs of rapid industrialisation of a country formerly regarded as mainly agricultural of which two-fifths of its 100,000 square miles was wooded. During six alternative post-conference

On this page: Tapping an electric furnace at the iron and steel works at Zenica (left) and the Parliament Houses, Belgrade

On opposite page: 1. Interior of the "Rade Koncar" factory at Zagreb, largest electro-industrial firm in Yugoslavia. 2. Map showing some of the principal industries and hydro-electric stations. 3. A cement factory at Skopia

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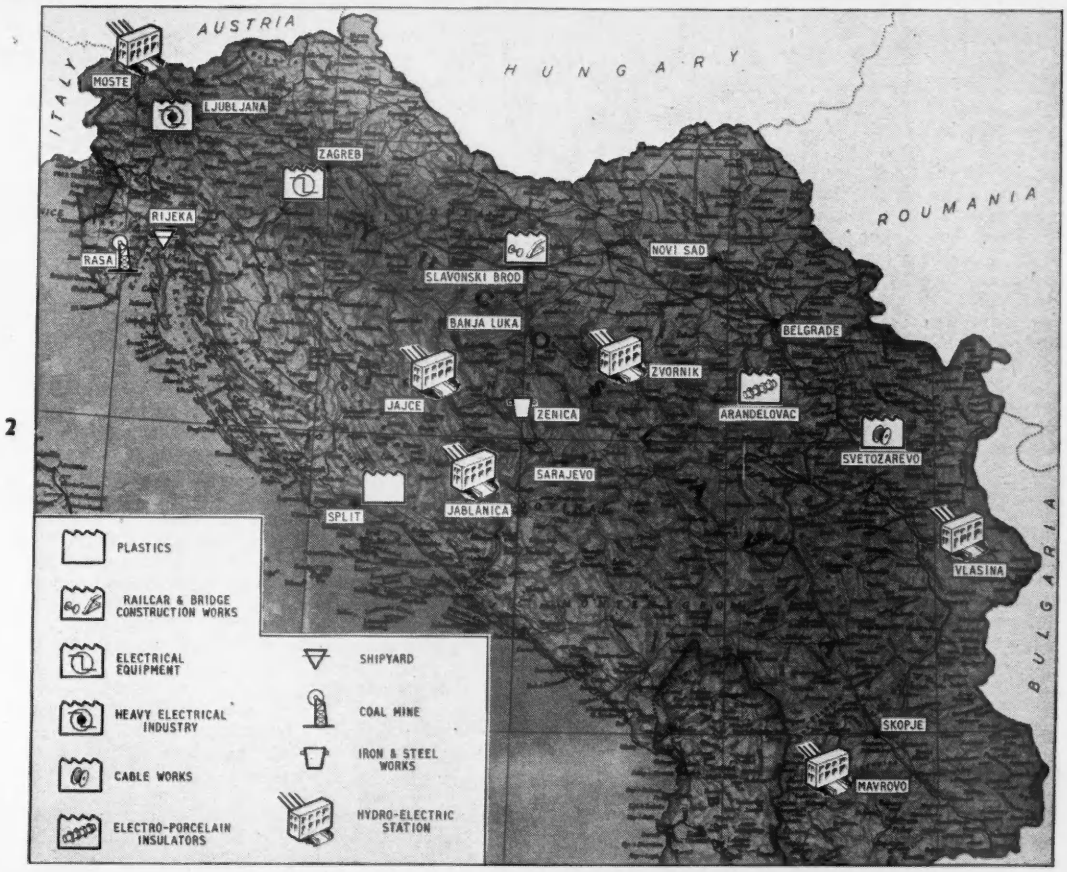
AUSTRIA
HUNGARY
ITALY
ROUMANIA
BULGARIA
MOSTE
LJUBLJANA
ZAGREB
RIJEKA
RASA
SLAVONSKI BROD
NOVI SAD
BANJA LUKA
BELGRADE
ZVORNIK
JAJCE
ZENICA
ARANDELOVAC
SVETOZAREVO
SARAJEVO
JABLANICA
SPLIT
VLASINA
SKOPJE
MAVROVO
PLASTICS
RAILCAR & BRIDGE CONSTRUCTION WORKS
ELECTRICAL EQUIPMENT
HEAVY ELECTRICAL INDUSTRY
CABLE WORKS
ELECTRO-PORCELAIN INSULATORS
SHIPYARD
COAL MINE
IRON & STEEL WORKS
HYDRO-ELECTRIC STATION

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tours or during the conference itself, visits will be paid to such places of electrical interest as the Institute for Nuclear Sciences, a porcelain insulator factory, works for the manufacture of turbines, major electrical equipment and cables and six hydro-electric stations. One of those stations, at Jablianca, is especially noteworthy in that five of the six 31,000 h.p. Francis turbines and their associated alternators and transformers and other equipment were manufactured in one or other of the works referred to above.

Extraneous interest is attached to another station in the neighbourhood beyond its installation of 28 MW Pelton wheels, operating under a head of 2,000ft, and some pumped storage plants. This is the Nikola Tesla station named in commemoration of the famous Serbian engineer, the centenary of whose birth was celebrated last July.

The occasion was marked by a recommendation of the International Electro-Technical Commission that the "tesla" should be adopted as the M.K.S. unit of magnetic field strength. To him is attributed the design of the first practicable induction motor, the three-phase four-wire system of distribution as well as the induction coil which bears his name. Reports on the technical and social aspects of the conference will appear in later issues of the *Electrical Review*.

Trade Union Policy

THE PROGRAMME FOR NEXT WEEK'S E.T.U. CONFERENCE

SUBJECTS to be dealt with at next week's annual delegate conference of the Electrical Trades Union at Folkestone include automation and the effects of the Electricity Bill besides the usual questions of rates of pay, holidays, apprentice training, etc.

Altogether there are 188 motions on the agenda, three-fifths of which deal with industrial and trade subjects. Twenty-eight are concerned with the electrical contracting industry. Thus, a Reading motion calls for an electricians' charter, "based upon and incorporating the demands passed at . . . previous conferences." Three others return to the much-discussed subject of the contracting departments of the Area Electricity Boards. Weston-super-Mare "requests the Executive Council to treat as a matter of urgency the position of the loyal minority of contracting electricians working for Area Boards at the bare contracting rate on the Union's instructions since 1948." A composite motion wants one agreement to cover all contracting departments. The third motion, from Dukinfield, if more critical, does suggest a method of settlement. While it deprecates what it describes as "the obstructionist attitude of the Central Electricity Authority," it also criticises the approach and methods of the Executive Council which, it says, have operated against members and, in particular, the apprentice "who is denied the facilities of a comprehensive training." It calls upon the Executive Council to make one more approach to the C.E.A. and, should no agreement result, suggests that the whole case should be referred to the Industrial Disputes Tribunal.

The Harrow branch "views with alarm the progress being made by the Executive Council with regard to a national rate for contracting members," and proposes that local conferences should be organised in the Grade "A" area to obtain the views of these members and to be attended by members in surrounding rural branches.

Two motions call for increases in the rates of pay of apprentices and a composite one asks for a five-day working week. From Peterborough there is a proposal that one week's notice of termination of employment should be given.

There are the usual demands for increased wages. Isle of Thanet wants a return to a wage related to the cost of living, "as in 1947," with annual increases that will double the standard of living in 25 years as promised by the Government.

There are two motions on wages in the electricity supply industry. The first requests the Executive Council "to seek to amend the wages agreements of all manual workers so that they are on a parity with the National Joint Board." Barrow wants percentage increases, "in order to maintain the existing differentials between grades."

A composite motion, sponsored by eight branches, states that there is growing unrest among the manual workers because of the anomalies that exist between the conditions of service of the clerical and administrative workers and those of the manual workers. Urgent representations should be made for a revision of the agreement covering holidays, sick pay, hours of work and superannuation, "in order that these shall be placed at least on a parity with those applicable to the clerical and administrative grades."

The Royston branch wants a reduction in the retirement age from 65 to 60, and Ipswich calls for an additional week's holiday with pay, "to be taken outside the present stipulated holiday period."

Effects of Automation

Of general motions, there are four on automation. Stirchley is of the opinion that the full benefits of automation can be realised only by nationalisation of all the major industries "within the framework of a national economic plan." Failure to produce and operate such a plan, the branch asserts, "has resulted in wholesale dismissals and redundancy, bringing considerable hardship and industrial unrest." What is required is a more militant policy by the whole trade union movement to obtain for a redundant worker alternative work without loss of pay until suitable employment is found. A London motion asks Parliament to set up a permanent committee "to study the needs of and effect of automation in industry and agriculture," to "be drawn from a wide range of trade unions, employers' organisations, the nationalised industries, and technical bodies."

The old question of the registration of electrical operatives is again taken up in a composite motion. It calls for a State registration scheme for both operatives and contractors. Only those registered should be allowed to carry out electrical work. A further composite motion "reaffirms the determination of the Union to press for the introduction of non-contributory pension schemes for all sections of industry."

The Electricity Bill is the subject of a composite motion sponsored by two London station engineers' branches which feel that "the increased autonomy to be given to the Area Boards will not necessarily add to the efficiency of the industry—and may well lead to difficulties in negotiation." This, the branches state, is not in the best interests of the industry, and "will in our view be a retreat from the principles of nationalisation."

The Executive Council's report to the conference records an increase in membership during 1956 of 4,556, to a total of 228,156, organised in 695 branches. Solely a policy conference, it is unlikely that the depleted state of the union's finances will be discussed at Folkestone, though reference to it cannot be ruled out. This will have to wait until later in the year, when it is proposed to hold a rules revision conference to deal with contributions, levies, benefits and other matters connected with finance.

Series Capacitors

IMPROVEMENT of voltage regulation through the use of series capacitors in transmission and distribution lines furnished the theme of a paper presented on 22nd May by Mr. J. M. Magowan (Electricity Supply Commission, Southern Rhodesia) before the Supply Section of the Institution of Electrical Engineers.

The function of such capacitors, he stated, was not entirely to replace inductive equipment but rather to complement it. In certain circumstances they were regarded as providing the only solution to problems of supplying widely dispersed consumers. Capacitors in series with lines supplying inductive loads reduced voltage drop by compensating for the inductive reactance of the line, whereas those shunting load centres reduced the voltage-current phase displacement and thus the voltage drop. The former was shown to be technically superior for boosting voltage, especially for low kW-mile loadings at a power factor of about 0·7, and to be less costly in capacitor rating for over-compensation. The possibility of dispensing with capacitor protective equipment for certain types of distribution line was suggested.

Examples were given of favourable results achieved with existing 11 kV and 88 kV lines in Southern Rhodesia. In one area supply was derived from a 33/11 kV substation and owing to the loading conditions the automatic on-load tap-changing equipment operated on the highest tap position most of the time. After the installation of series capacitors the improved range of this equipment was shown by an increase in the average number of tap changes per day from 4·6 to 26. In another system the load by 1959-60 was expected to cause a voltage drop at the 88 kV busbars of the substation of 20 per cent at 0·85 power factor, which would be increased on the 33 kV radial feeders, all transformers being operated on the highest tap position. Series capacitors had been installed to give a line-to-line boost of 9·4 per cent, which would also permit efficient use of the automatic on-load tap-changers.

DISCUSSION

Mr. W. Casson (C.E.A.), opening the discussion, referred to the protection of series capacitors as probably the most difficult aspect of their application. The need to provide protection could be avoided only by using special types with more insulation than standard types used for shunt working, or when the through-fault and initial-fault current through the capacitors did not produce voltages across them which would permanently damage them. It was not very economical to put in more insulation, which was very expensive. A commercial risk might sometimes be taken when the fault currents produced voltages which would only reduce the life of the capacitor and not destroy it. The supply industry in Great Britain proposed to install several series capacitor installations as a research project.

Mr. W. S. Lovely (Merz and McLellan) referred to the comment in the paper regarding the loss due to shunt damping resistors, but said that fortunately the high resistance of light construction lines made them unnecessary. With large capacitor installations on lines of low "β" value a resistor might be necessary and the loss accepted.

The situation that had arisen on two 11 kV distribution feeders described in the paper which suffered from excessive voltage drop due to an unexpectedly rapid load increase was less likely to occur in this country where compact communities were the rule. However, even if the time factor had not caused bother, the use of capacitors in the manner suggested would still be an economical way to make greater use of the rural distributors.

Siting of Capacitors

Mr. R. O. M. Powell (B.I.C.C.) said that the main obstacle to the full exploitation of series capacitors seemed to be purely the lack of suitable protective gear. The capacitor was very sensitive to over-voltages, and whilst experimental installations of low-power banks without specific protective gear could be regarded as satisfactory, such installations were uneconomic when larger capacitor ratings had to be considered for overhead lines. Information on the siting of series capacitors in overhead lines would have been welcome, as, depending upon the degree of compensation and the location of the capacitor, a consumer connected immediately on its supply side could experience severe over-voltages when fault current flowed through it.

In addition, the position of the capacitor could have repercussions on the rating of circuit-breakers and the operating of generating equipment under fault conditions.

Mr. M. Waters (E.R.A.) agreed that the development of suitable protective devices was highly important, pending which there would not be much scope for series capacitors in the United Kingdom.

Mr. G. R. Falkiner Nuttall (Balfour Beatty) showed by means of a number of slides that the problems being dealt with in Kenya and Tanganyika were similar to those outlined in the paper.

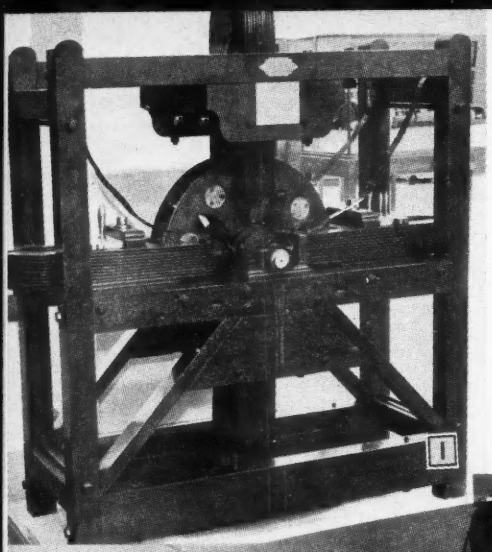
Mr. K. M. Jones (B.T.H.) mentioned the benefit of applying series capacitors to transient stability problems, which presented a big problem on high-voltage systems. Where there was alternative feed between any two points it was an advantage for series capacitors not to flash over when there was a fault at the most severe location in the system as regards transient stability. The series capacitors must be kept away from load busbars, particularly where induction motors were present.

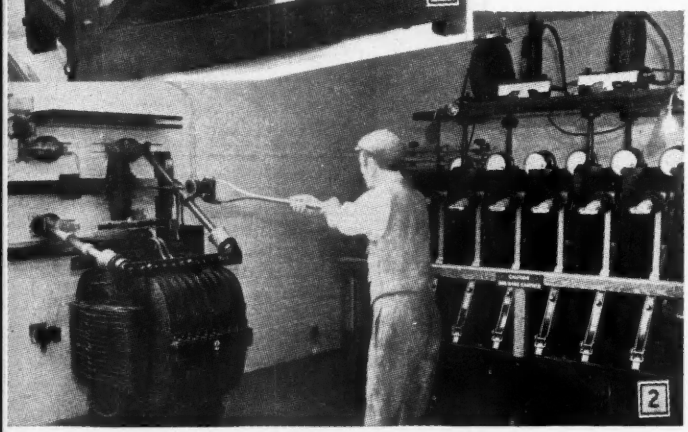
Mr. A. J. Haselfoot (Fuller Electrical Co.) said that a useful method of presenting the voltage performance of series capacitors was by the ordinary circle diagram. A given rating of capacitor, whether series or shunt, would give the same reduction in line loss up to the first load point after its installation. As the shunt capacitor was usually installed at the far end of the line, it would give greater improvement in line loss. Where a reduction of voltage regulation was the prime requirement, then the series capacitor would probably be the better.

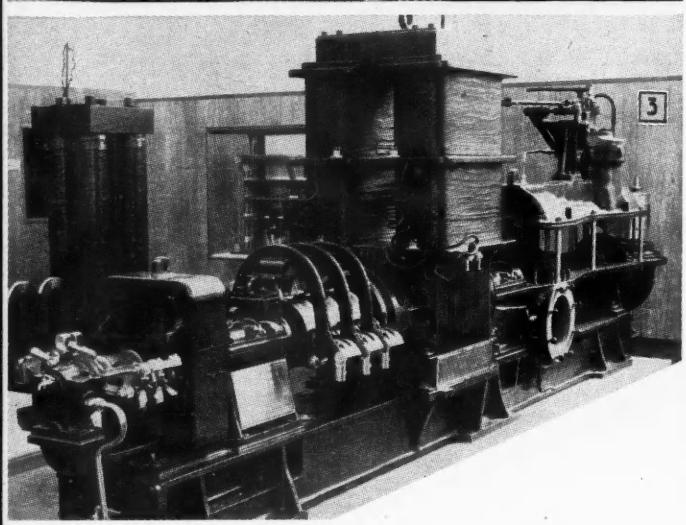
Mr. S. C. Chu (S. T. and C.) understood that more compensation per ohm could be obtained when the capacitor was inserted at the centre point, which had the further advantage of lowering the fault current. Although the author stated that no resonance had occurred, there was no evidence of that. In Sweden such disturbances occurred quite often and they had adopted a kind of protection using a relay which was sensitive to subharmonics. The relay would short-circuit the series capacitor momentarily and put it back into the line again. The subharmonics disappeared like magic.

ELECTRIC POWER AT TH SCIE

INDUSTRY ASSISTS IN FORMING NEW COLLECTION





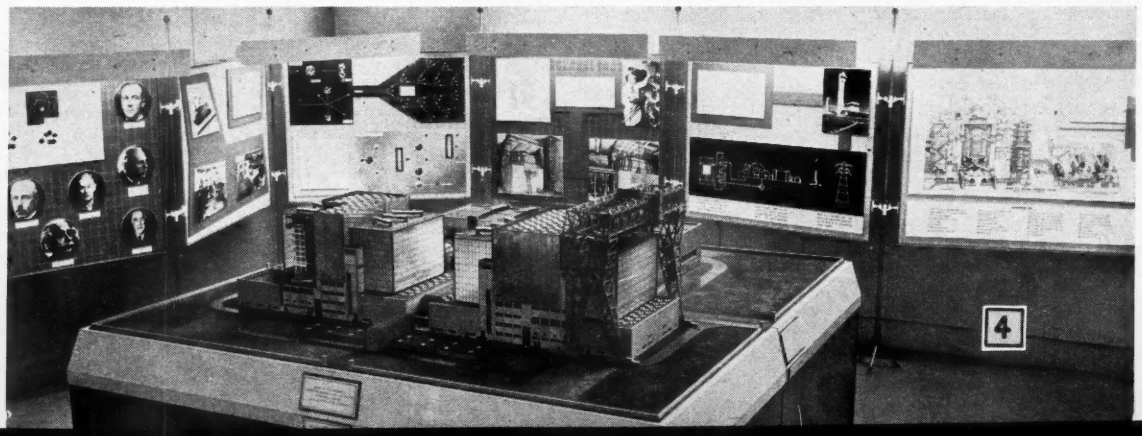


THE Electric Power Collection, opened in its new 12,000 sq ft gallery by Lord Hailsham on 20th May, is the result of several years of close co-operation between the Science Museum and the electrical industry, working through the Exhibitions Committee of the Institution of Electrical Engineers. The cost of its development was about £75,000; one-third of this has been borne by the Government, through services performed by the Ministry of Works in the building, decorating and furnishing of the gallery; the remainder by the electrical industry, partly in money for the purchase of specially commissioned exhibits, and partly by the direct provision of exhibits. The industry's contributions have been channelled mainly through the Central Electricity Authority and Area Boards on the supply side, and mainly through the British Electrical and Allied Manufacturers' Association and the Cable Makers' Association on the manufacturing side.

The new gallery is situated on the ground floor, and one comes to it after passing through the collection dealing with the primary sources of energy and their application to man's use. It forms a natural continuation since, of course, it shows the conversion of this energy into a form in which it can be conveniently distributed for utilisation wherever it is needed.

The collection covers the development of electric power from the 1831 work of Faraday, when he generated the first continuous electric current, up to the generation of electric power from nuclear energy, and it even includes a glance into the future possibilities of the fusion of hydrogen as a source of heat for the production of steam. The earlier period is illustrated by a selection of the historically important apparatus and machines collected by the Museum over the years. Dioramas are used to portray scenes from the early history of the subject, and two models of note are Ferranti's Deptford power station and Edison's Pearl Street station, both made in the Museum's workshops. Part of the Trafalgar Square substation of Deptford, which was preserved in Cockspur Street for many years, at first by the London Electricity Supply Corporation and then by the London Electricity Board, has been re-erected in one corner of the gallery. The first three-phase alternator, made by C. A. Parsons, is being exhibited for the first time, and the comprehensive

1. Replica of the Woolrich machine which was probably the first industrial electric machine of any size. Used for electro-plating, it was made in 1844. 2. The Trafalgar Square substation of Deptford power station, 1891. 3. The first three-phase turbo-alternator was made by Parsons in 1900 with a rating of 150 kW. 4. The nuclear power section of the gallery



SCIENCE MUSEUM

By MARGARET WESTON, B.Sc.(Eng.), A.M.I.E.E.*

Hunter-Hazell historical collection of power cables, which has been presented to the Museum comparatively recently, is now well displayed in a series of wall cases.

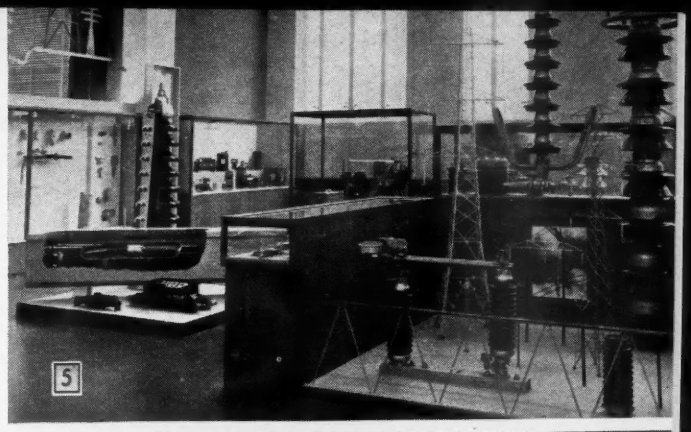
Engineers who were in the gallery during its preparation usually found something to interest them among the historical exhibits. For example, it was frequently remarked that the core construction of the Ferranti transformers of the 1880's was very similar to that of the cold rolled steel cores of to-day, that the Westinghouse circuit-breaker from Clyde Valley was a wonderful example of "minimum oil," and that this or that constructional detail was remarkable, extraordinary, or amazingly crude.

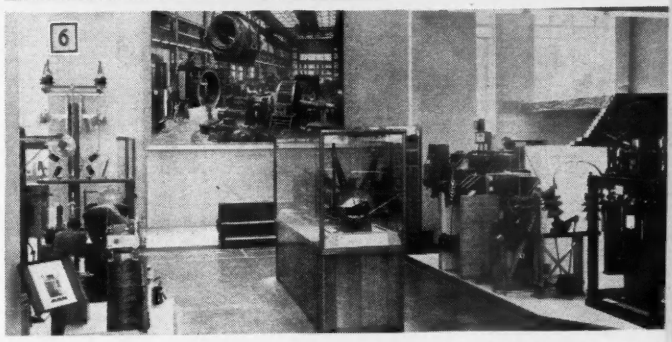
Modern practice is dealt with in a sequence including exhibits on generation, transmission, distribution and utilisation. As far as possible actual pieces of equipment are shown; even the rectifier, which was recently installed to supply d.c. to the Museum, has been modified to form an exhibit. Of the many working exhibits the one million volt impulse generator, having eighteen stages of 0·09 μF each and a maximum energy of 2·45 kilojoules, is undoubtedly the most spectacular, but it was thought that it would prove a trifle disturbing to permit operation by members of the public, so demonstrations are arranged to be held twice daily.

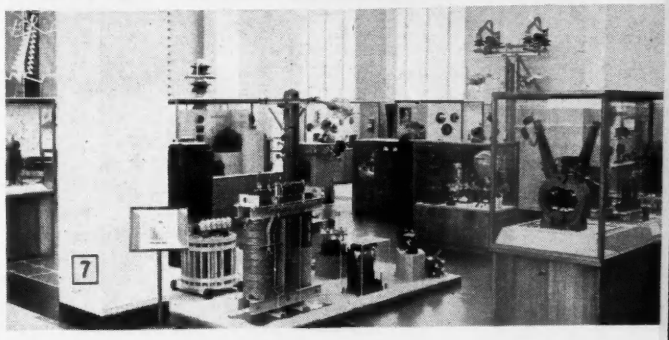
Another section of working exhibits, on speed and voltage control, includes a schrage motor, amplidyne, Ward-Leonard set, and a grid-controlled mercury-arc rectifier regulating the speed of a motor. A working, sectioned, squirrel cage rotor induction motor sometimes causes comment. Several other larger motors are nicely sectioned, and the construction of small universal and squirrel cage motors is shown in stages, culminating in the finished working equipment.

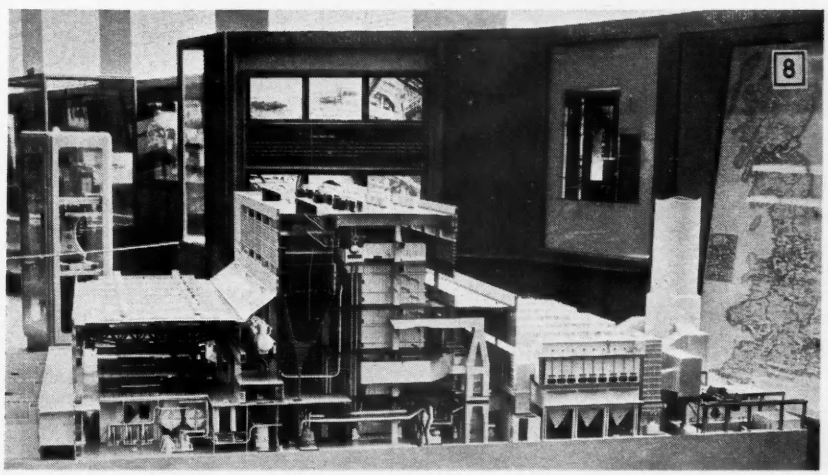
In some cases when it is not possible to show the whole, a part of the equipment is shown together with a model. This has been done, for example, in the case of the 100 MW hydrogen-cooled alternator; a sectioned working model and an actual half-coil from the stator are shown. In the case of overhead transmission lines, a 275 kV suspension type insulator string is hung from its cross-arm over a plinth showing model pylons, unit insulators of various types, and line fittings. The section on modern power cables has a display in model and diorama form

* Assistant Keeper in charge of the Electric Power Collection.









5. General view of the transmission lines section. 6. Part of the switchgear and transformer section. 7. General view of the new gallery showing the one million volt impulse generator in the background. 8. Model of Castle Donington power station made by Bassett-Lowke

illustrating their use, and shows a 132 kV three-phase joint and sealing end. In modern switchgear, it has been possible to show a 1,600 A air-blast circuit-breaker, and metalclad gear for 11 kV of 350 MVA rating, but equipment of higher ratings is illustrated by a fairly comprehensive range of models. However, an actual air-blast head is shown in conjunction with the 275 kV air-blast circuit-breaker model.

In other instances exhibits have been mounted as they are used; a pole-mounting transformer for rural distribution has been mounted on a pole together with all the ancillary equipment, and its associated isolating switch- and fuse-gear have been fixed on an adjacent pole.

The scale of electrical engineering does, of course, necessitate recourse to models in a large number of instances, and some interesting modern models are included in the Collection. That of the Castle Donington thermal power station to a scale of $\frac{3}{16}$in to the foot is perhaps one of the most impressive, and the model of Uskmouth power station showing part of the turbine floor and the condensing plant below is also extremely detailed. Hydro-electric generation is illustrated by a model of the Karapiro power station in New Zealand, and one of the Invergarry water wheel alternator which is constructed so that the turbine blades correctly alter in pitch as the shaft rotates. The 40,000 kVA, 22 kV synchronous condenser model was made originally to show how this type of machine can be assembled with the use of only a three-ton crane.

A display on the generation of electricity and its distribution by the grid incorporates models and transparencies, and has as its central feature an iluminated map of the grid system.

Models of the Bradwell and Berkeley nuclear power stations are shown in a separate section, at the end of the gallery, which traces the development of nuclear energy and its application to the generation of electricity.

Two other models utilise part of actual equipment in a modified form. A 300 kVA transformer core has a half-taped limb showing the stepped core, a limb wound with the l.v. and part wound with a h.v. continuous disc-type winding with transposing crossovers, and a third limb wound with a section type winding normally used for larger ratings. An actual 132 kV bushing is exhibited, and a 380 kV bushing is illustrated by a full size model having a wire profile of the porcelain and the oil end, which also enables the re-entrant portion to be seen.

The building itself is spacious and light, and, as is particularly appropriate to an electrical gallery, a special feature has been made of its illumination. Four 100ft rows of warm white fluorescent tubes suspended from the ceiling on thin steel wires light the sides of the gallery, while down the centre are four rows of cold cathode lights fixed flush to the ceiling.

Decorative features which contribute to the general atmosphere are two large metal screens, forming partial partitions, in designs symbolising the function of the impulse generator and the use of nuclear energy in the generation of electricity. A very large painting of a turbo-alternator shop, so arranged that it gives one the impression of looking into the actual factory, has a somewhat dual purpose, for together with its annotated line drawing it also forms an instructive exhibit.

It is believed that the exposition of the development of the electric power industry in this gallery has much in it to interest the general public, and that it will also be of value to the student. In particular it may be hoped that, by stimulating interest in the technology and achievements of the electrical industry, the gallery may contribute something to the solution of the problem of how to attract more young people into science and engineering. For the electrical engineer the main interest will perhaps be in those parts of the Collection which lie outside his own particular field of specialisation.

Tasmanian Construction Programme

Uncertainties and variations in the annual allocations of funds for power development are inimical to efficiency, the Hydro-Electric Commission of Tasmania points out in its latest report (for 1955-56). To meet the country's needs it is essential that the programme should be planned for several years ahead, but for this purpose adequate funds must be provided. In the year covered by the report the amount available was again curtailed, capital expenditure being only £8·2 million against £9·8 million in the previous year and £10 million in 1953-54.

The present annual output capacity of the Commission's system, based on a long term average rainfall, is assessed at 1,884 million kWh and it is thought that the requirements during the present year may exceed this figure. In the year ended 30th June, 1956, 1,549 million kWh was sold, an increase of nearly 17 per cent over the previous year. A further measure of the rate of development is afforded by the rise in the average consumption per consumer which is now 5,500 kWh a year. More than 70 per cent of the domestic consumers use electric cookers and 58 per cent have electric hot water services.

Although the programme was somewhat reduced, good progress was made during the year on civil engineering investigations, design and construction. Comprehensive reports on both the Great Lake and Derwent-Dee schemes were prepared and investigations were also carried out on alternative proposals for Arthur Lake. The most immediate new development contemplated is the construction of a dam and power station on the Derwent River about four miles downstream from the Wayatinah "B" power station. This scheme, to be called Catagunya, will use the whole of the waters flowing through Tarraleah and Tungatinah power stations as well as water from the Florentine River, and will add some 200 million kWh to the average annual output.

Linear Accelerator for Industrial Radiography

A 5 MeV linear accelerator has recently been installed at a Ministry of Supply establishment. This machine, believed to be the first of its kind, was designed and constructed specifically for industrial radiography by Mullard Research Laboratories.

The outstanding advantage of linear accelerators is that they give more X-ray output and greater energy than machines previously used for radiography, including Van de Graaf machines, resonant transformers, and cascade generators. The machine also compares favourably with multi-curie radioisotope sources such as Cobalt 60. For example, a half-hour exposure using the linear accelerator will give a radiograph of the best obtainable definition of a steel specimen 9 or 10in thick, whereas the same exposure using a Cobalt 60 source of reasonable size would only give about 5in penetration.

The accelerator has been designed to give extremely good definition. Despite the high energy and the large output of over 500 röntgens/min at 1 metre the electron beam which creates the X-rays has a diameter of only 2 mm when it strikes the target. In addition, the polar diagram of the output tends to be flatter than is normally associated with such a high energy beam because of a special new magnetic focusing device associated with the X-ray head.

The main part of the machine has been kept small, the overall length being only 9ft. This has made it possible to obtain a very high degree of mobility so that the accelerator can be moved into the best position for obtaining a radiograph, instead of moving the specimen.

Hydro-Electric Plant in Russia

British Delegation's Report on its Visit

THE report of a British delegation appointed by the Institutions of Civil, Mechanical and Electrical Engineers, in association with the British Council, to study hydro-electric developments in the U.S.S.R., was presented on 20th May at a joint meeting of the three Institutions. The delegation, which spent thirteen days in Russia last October, was led by Sir John Hacking (Merz & McLellan). Other members were: Mr. A. A. Fulton (North of Scotland Hydro-Electric Board); Dr. S. P. Hutton (D.S.I.R.); Dr. W. MacGregor (Geo. Wimpey & Co.); Mr. R. W. Mountain (Kennedy & Donkin); and Mr. H. West (Metropolitan-Vickers Electrical Co.).

In 1955 170,000 million kWh was generated, of which 46,000 million came from industrial and isolated plants. Of the 124,000 million produced for the Ministry of Power Stations, 21,400 million was from hydro stations. About 30 per cent of the installed capacity in thermal stations is designed also for district heating. By 1960 the overall total is expected to reach 320,000 million kWh, including 59,000 million from hydro-electric stations. Water power potential, allowing for a 50 per cent development as feasible, is about 1,500,000 million kWh. Twenty-one rivers have a probable utilisable potential of over 10,000 million kWh each, but only one of these, the Volga, is in Europe, where only one-fifth of the total U.S.S.R. potential is situated. The Volga is 3,688 km long and has a catchment area of 1·38 million sq km, which is greater than the combined area of England, France and Germany. It contains one-third of the whole population (210 million) of the U.S.S.R. and it also produces half the present industrial output.

Chief developments on the Rivers Volga and Dnieper are shown on the accompanying map and some particulars of the Volga stations are given in the table here reproduced. Further technical details are included in the report. Costs are taken at a realistic exchange rate of 45 roubles to the £ and are similar to those to be expected in British practice for equivalent load factors. At the official exchange rate the cost figures stated would be multiplied by four. The Volga schemes also provide for navigation and irrigation.

A third scheme visited was in Armenia, where eight hydro stations, with an aggregate installed capacity of 600 MW, are or will be in operation on the River Razdan, which flows out of Lake Sevan (area, 1,416 sq km) and falls 1,100 metres during its course. Nuclear energy plants are expected to play a large part in the development of Armenia.

Information on hydro-electric stations to the east of the Urals (not visited by the delegation) indicates that a station now being built at Bratsk on the River Angara will have individual units of 200 MW and a total installed capacity of 3,200 MW and that another station at Krasnoyarsh on the River Yenesi will have 300 MW units and a capacity of 3,600 MW.

The River Ob in Siberia (4,000 km in length) is said

CAPACITIES AND COSTS OF VOLGA STATIONS

Station	Plant installed MW	Average kWh/annum × 10⁹	Average load factor/annum per cent	Capital costs/kW £	Annual fixed charges/kW at 6 per cent £	Fixed charges/kWh d	Running charges/kWh d	Total charges/kWh d
Molotov ...	504	1·9	43·0	117	7·01	0·446	0·133	0·579
Votinsk ...	540	1·9	40·2	102	6·11	0·416	0·101	0·517
Lower Kama	1,000	4·4	50·2	117	7·01	0·383	0·112	0·495
Ivanov ...	30	0·12	45·6	258	16·30	0·982	0·160	1·142
Uglitsk ...	110	0·24	24·9	208	12·45	1·380	0·181	1·562
Tchbakov ...	330	1·1	38·1	163	9·79	0·705	0·144	0·849
Gorki ...	400	1·46	41·6	138	8·29	0·544	0·176	0·720
Chebokssary	840	3·8	51·5	141	8·46	0·447	0·144	0·591
Kuibishev ...	2,100	11·3	61·5	95·5	5·72	0·250	0·0748	0·3248
Saratov ...	1,000	6·0	68·5	133	7·99	0·3185	0·112	0·4305
Stalingrad ...	2,310	10·9	53·9	73·3	4·40	0·224	0·0695	0·2935
All stations ..	9,164	43·02	53·8	108	6·48	0·340	0·0985	0·5940

Hydro-electric stations on the Rivers Volga and Dnieper

to have a potential with 50 per cent utilisation of 25,000 million kWh. The first station at Novosibirsk (400 MW) is nearly completed. Another, of 5,000 MW, is planned for the estuary of this river with an annual output of 30,000 million kWh at a load factor of nearly 100 per cent which will be transmitted 1,200 km to the Urals. A reservoir (which will take four years to fill) is to be constructed to provide 1,500 cu km of water without spillway, the total flow of water passing through the turbines. General particulars were given of other hydro plants of up to 5,000 MW under construction or projected in Siberia.

Five separately interconnected transmission systems are in service or projected as follows: Moscow and Upper Volga; southern part of the Dnieper, Donetz and Lower Volga; Urals; Leningrad and Estonia; area between the Black and Caspian Seas. Technical particulars of these systems, which provide for the use of 400 kV a.c. and d.c., were given in the *Electrical Review* of 3rd May.

Three hydraulic research stations were visited. Two, at Leningrad and Moscow, with staffs of 650 and 570 (including a high proportion of women scientists), belong to the Ministry of Power Stations. The third, with a staff of 190, is part of the Armenian Academy of Sciences.

Manufacture of Plant

Russian industry, the delegation considers, is now capable of designing and making all types of plant required. Visits were paid to two large manufacturing works at Leningrad, one making thermal and hydraulic turbines and the other generators. Though old they are equipped with many up-to-date tools. Simplification of design is an aim in order to save material and construction time, finish in workmanship being confined to essentials.

The current five-year plan envisages the production in its last year, 1960, of 10,500 MW of thermal turbines and 2,600 MW of hydraulic turbines with their generators. Steam conditions will be generally 130 atm and 565 deg C with reheating and the boiler-turbine unitary system will be introduced; 200 MW sets will be designed for 220 atm and 600 deg C and 300 MW sets for 300 atm and 650 deg C. The proposals include the building of 2,000 to 2,500 MW of nuclear power plant by 1960.

Sir John Hacking, in presenting the report, referred to the trial horizontal " semi-axial flow " 21 MW set at the Molotov station on the River Kama, saying that a turbine of this type might be installed in Scotland.

Mr. T. A. L. Paton (Sir Alexander Gibb & Partners) asked what happened in Russia to an engineer who did not get on with his fellows or who might be incompetent, and whether the risk of failure led to caution which impeded the progress of work.

Mr. K. H. Tuson (Mackness & Shipley) expressed interest in the use of competitive tenders in Russia, since the relative efficiencies of " capitalist " and Soviet methods were of the utmost importance. It was difficult to see how factories in the Soviet Union could compete, since they were directed from a common Ministry. On the other hand, since all the factors except brains, skill and energy were common, there might be much truer competition than could be obtained in any other way.

Mr. E. S. Booth (C.E.A.) pointed out that thermal-electric generation in the U.S.S.R. was planned to advance at similar rates to hydro-electric generation. The installed capacity was expected to increase by 89 per cent from 1955 to 1960, to a gross capacity of 57,700 MW. In 1955 thermal stations supplied 86½ per cent of the country's requirements, and in 1960 they would supply 80 per cent. Nearly one-third of the total steam plant was associated with the supply of electricity and of steam for heating or process purposes, the 25 and 50 MW sets being standardised for this duty. Broadly speaking, the plant made in the Soviet Union was of a good standard in its essential engineering features, but work executed on site was below the standard in this country. Thermal efficiencies of Soviet stations seemed to be about two points below similar stations in this country.

Mr. F. S. Jackson (Marples Ridgway & Partners), as a contractor, said it was impossible on present information to form a definite opinion on the relative efficiency in construction work of Russia and this country as measured by kW installed against productive effort. The figures in the report suggested that the Russians were going ahead in this respect in spite of their not having contractors. He thought that in this country neither the engineers specifying nor the contractors carrying out work made sufficient distinction in the appearance of finished work between what really mattered and what did not. Hydro-electric generating stations were observed by very many people and must be satisfying, but comparable standards were often applied, wholly in theory and partly in practice, to structures which were permanently invisible. There was scope in this country for more installed kVA per annum with rather less in the way of very smooth and accurately-aligned surfaces for sheep to rub against.

Mr. Herbert Addison (hydraulics consultant) commented on the credit given to scientists rather than to engineers in research in Russia.

Power Station Staff Salaries

Mr. D. P. Sayers (C.E.A.) said that the power engineers' delegation to Russia had been impressed by the large place which the bonus system occupied throughout the structure of salaries and wages; for the operating staffs in power stations bonuses could about double the basic wage. The Russian attitude of concentrating on essentials seemed to apply to electricity supply policy. When his delegation visited the Soviet Union the domestic consumer seemed to be regarded almost as a nuisance and as far as possible the output of electricity was devoted to greater industrialisation. Nevertheless, from the planned increases in output of various items in 1960 as compared with 1955, the two largest increases were in domestic refrigerators (419 per cent) and domestic washing machines (608 per cent). This seemed to indicate that policy was being liberalised.

Mr. F. Newhouse (Sir M. MacDonald & Partners) remarked that hydro-electric schemes in this country were constantly regarded by those who benefited by them of " uglifying " the lakes of Scotland and Wales. The Russians were going to do a great deal of damage to the appearance of their country, though he hoped they would do a great deal of good to its people. How was it possible to balance loss of beauty against material benefits? It was very important that it should be measured.

Mr. Gerald Lacey said that in the Russian hydro-electric works he had seen there had been a concentration on results, and, while the finish was poor, in the parts which really mattered the workmanship appeared to be good.

Sir John Hacking, in reply, referring to the cost of the Russian schemes, emphasised that they served three purposes—electrical generation, navigation and irrigation —but said he had seen no attempt to divide the cost between the three. In Great Britain each factor in the economy of the country was examined individually and a decision taken on its economic merits, but in the Soviet Union a broad view was taken. It was not a question of calculating whether the Volga scheme was economic but of seeing whether or no it fitted into the general pattern of the national economy.

OVERSEAS ELECTRICAL TRADE

SET-BACK IN ELECTRICAL EXPORTS IN APRIL

AFTER showing increases for each of the preceding two months, exports of British electrical machinery and apparatus in April suffered a set-back, the value of £17,490,783 being nearly £3,000,000 less than for March and over £600,000 below the figure for April, 1956. The fall was general in all the main groups.

Exports of generating sets, generators and motors at £2,509,072, compare with £3,374,045 in March and £3,064,498 in April, 1956. The value of exports of converting machinery, mercury-arc rectifiers, transformers, switchgear, etc., £2,443,825, was only slightly lower than the figure of £2,560,884 for March, but was over £500,000 below that for the corresponding month of 1956. Radio and associated equipment at £2,770,689 was about £200,000 down on the March figure, but was nevertheless higher by some £200,000 as compared with April last year.

Telegraph and telephone equipment exports dropped by nearly £400,000 in the month to £1,428,119, but as compared with April last year there was little change. In the cables and wires group exports fell by over £500,000

TABLE I.—ELECTRICAL EXPORTS

Class	April 1957	Four months ended April 1956	Four months ended April 1957
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	132,375	506,689	602,869
Ditto, 10 to 65 kW	136,047	447,282	616,851
Ditto, 65 to 200 kW	57,004	576,234	384,048
Ditto, over 200 kW	91,383	1,283,447	1,007,189
Spark ignition engine driven	15,069	177,551	59,288
Steam turbine driven	50,509	127,581	230,292
Hydraulic turbine driven	—	145,529	—
Other prime mover driven	68,078	319,446	111,271
Generators, not exceeding 200 kW	131,663	481,885	630,136
Ditto, over 200 kW	48,219	381,567	293,394
Parts of generators	399,719	2,314,351	1,709,731
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	211,389	827,589	800,663
Over ½ but under 1 h.p.	41,597	239,955	195,885
1 h.p. to 250 h.p.	475,835	1,721,754	2,007,840
Over 250 h.p.	94,172	273,086	439,673
Railway, tramway and trolley-bus motors complete and parts of all motors	214,575	661,341	695,404
Motor starting and controlling gear	341,438	938,707	1,310,495
	2,509,072	11,423,994	11,095,029
Converting machinery	126,090	125,930	327,003
Mercury-arc rectifiers	88,303	286,387	204,301
Transformers for lighting, heating and power (incl. coils):			
Not exceeding 7,500 kVA	639,868	4,561,014	2,515,806
Over 7,500 kVA	146,652		865,279
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	335,731	992,361	1,288,831
Ditto, other	1,107,181	4,696,445	4,518,032
	2,443,825	10,662,137	9,719,252
Primary batteries:			
Lighting	89,008	328,460	396,195
Radio	183,644	927,596	1,098,375
Other	40,696	179,665	178,711
Parts (excl. carbons)	49,965	154,383	209,082
Lamps:			
Filament, exceeding 28 V*	90,721	404,988	347,402
Ditto, under 28 V*	24,248	122,763	132,256
Arc lamps and searchlights	14,010	78,010	57,812
Discharge lamps, fluorescent tubes, etc.	77,728	283,549	403,947
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	21,077	104,323	103,935
All other	281,677	801,215	1,125,632
Parts (excluding glass bulbs)	12,542	59,836	43,543
Radio and television transmitters	29,225	221,149	271,884
Commercial radio and radar equipment	1,288,075	4,558,245	5,045,152
Domestic radio receivers, mains	115,916	624,351	487,629
Ditto, battery	54,397	320,734	234,371
Ditto, other (incl. car)	18,854	104,203	98,965
Radiograms	31,394	147,625	112,969
Television sets	50,985	165,203	240,909
Public address equipment	80,350	362,922	390,179
Other radio and television apparatus, n.e.s.	34,739	135,467	234,009
Components and parts, n.e.s.	751,458	2,622,361	3,102,854
	2,770,689	10,227,634	11,492,031
Telegraph and telephone installations	486,878	2,539,353	2,446,832
Telephone instruments, separately consigned	121,750	474,865	682,407
Telegraph and telephone parts	709,325	2,185,287	3,308,021
Line apparatus for long distance commun.	110,166	539,447	362,620
	1,428,119	5,738,952	6,799,880

Class	April 1957	Four months ended April 1956	Four months ended April 1957
	£	£	£
Cookers	52,485	353,762	263,123
Toasters	30,478	78,275	73,773
Other cooking apparatus	30,342	145,071	127,193
Parts and accessories	71,444	350,904	291,007
Space heating appliances	31,131	199,112	149,304
Water heating appliances	32,803	138,264	126,143
Other heating appliances	44,304	161,989	176,622
Parts and accessories	63,861	261,737	251,202
Irons	69,510	435,837	262,203
Arc welding equipment, a.c.	55,607	238,038	240,467
Ditto, d.c.	33,065	190,258	179,644
Resistance welding equipment	19,463	92,598	98,150
Electric furnace plant	70,956	228,885	393,996
Magnetos, ignition	35,973	105,157	132,752
Sparking plugs	161,602	603,886	631,335
Elec. appliances for aeroplanes, n.e.s.	285,104	775,915	1,063,544
Ditto, for motor vehicles, n.e.s.	335,068	1,397,943	1,438,291
Ditto, for cycles, n.e.s.	82,369	317,218	233,168
Signalling app. (incl. traffic signals)	110,867	207,906	447,159
Instruments, commercial	209,911	706,349	761,482
House service meters (including parts)	98,675	719,685	663,770
Electro-medical apparatus (not X-ray)	31,559	149,875	127,149
X-ray apparatus (excl. tubes and valves)	61,850	259,386	253,891
Vacuum tubes	31,424	100,219	170,480
Ceiling fans, complete	139,139	418,180	460,069
Desk fans, complete and parts of desk and ceiling fans	41,830	118,394	147,399
Vacuum cleaners	108,652	495,071	595,767
Floor polishers	94,347	344,367	346,294
Food mixers	58,323	251,698	196,426
Hair clippers and dry shavers	72,735	314,533	328,466
Other portable appliances	29,282	120,931	117,383
Parts	134,296	477,705	512,209
Portable elec. tools (not saws) and parts	213,539	807,453	881,127
Cables and wires:			
Telegraph and telephone, submarine	73,704	190,689	184,284
Ditto, other	736,957	3,233,865	3,876,261
Cotton, silk or art. silk insulated	20,750	257,465	154,191
Enamel, glass or asbestos insulated	100,499	338,890	404,759
Paper insulated	1,022,734	4,070,668	3,432,648
Rubber insulated	472,366	1,997,206	2,218,567
Thermoplastic insulated	178,933	532,600	649,474
Other	193,718	934,070	806,709
	2,799,661	11,555,453	11,726,893
Accumulators for motor vehicles	150,353	739,669	585,276
Ditto, traction	37,811	97,856	122,778
Ditto, radio and other portable	78,620	332,499	344,631
Ditto, other	44,444	237,779	130,909
Parts and accessories	62,133	339,887	345,362
Elec. porcelain, etc. (incl. insulators), n.e.s.	104,694	417,352	449,848
Insulating cloth and tape	63,846	250,434	251,726
Other insulating material	97,275	382,539	372,807
Permanent magnets	37,296	170,602	182,430
Radio, telegraph and telephone testing equipment, n.e.s.	78,304	140,826	254,363
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	17,294	53,902	50,049
Other	225,634	784,600	1,168,302
Electrical machinery, n.e.s.	56,070	452,191	275,823
Electrical apparatus and appliances, n.e.s.	973,629	3,022,719	3,689,162
TOTAL	17,490,783	71,077,040	74,021,319

* The figures for 1957 are not completely comparable with those for previous years.

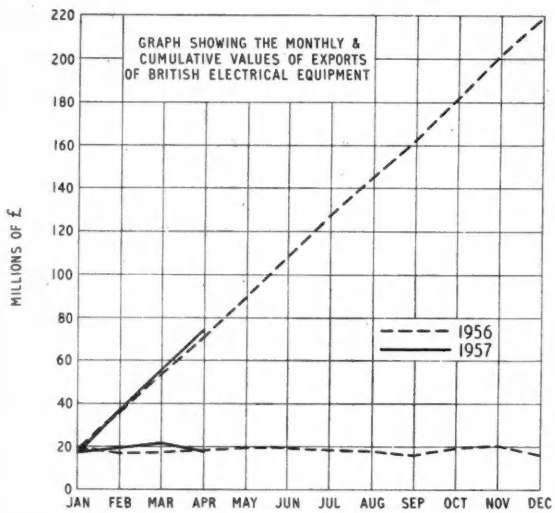
TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	April 1957	Four months ended April 1956	Four months ended April 1957
	£	£	£
Channel Islands	74,019	317,181	376,254
Gibraltar	14,947	166,323	48,645
Malta and Gozo	102,031	292,841	243,598
Cyprus	85,364	618,722	502,631
Sierra Leone	34,216	100,131	124,617
Gold Coast	164,569	579,644	672,227
Nigeria	246,591	1,201,464	1,104,387
Union of South Africa	1,486,736	5,416,504	5,879,522
Rhodesia and Nyasaland	457,134	2,195,132	2,021,197
Tanganyika	29,588	243,192	229,312
Kenya	174,182	942,078	1,010,045
Uganda	162,286	305,936	454,172
Mauritius	37,946	110,350	143,136
Aden	48,212	223,926	216,684
Bahrain, Qatar and Trucial States	64,899	377,610	557,462
Kuwait	380,831	455,604	977,311
India	1,933,424	6,895,322	8,318,953
Pakistan	257,663	1,073,361	1,208,597
Singapore	433,893	1,216,881	1,403,988
Federation of Malaya	223,787	1,119,776	1,211,003
Ceylon	85,956	613,001	577,320
British North Borneo	19,487	114,063	87,846
Sarawak	12,300	87,281	60,405
Hong Kong	208,185	791,810	919,308
Australia	1,594,664	7,226,767	6,469,162
New Zealand	568,270	3,688,884	3,682,844
Fiji	18,079	66,874	80,954
Canada	1,339,800	3,097,449	4,233,233
Jamaica	87,349	461,122	341,714
Barbados	13,362	121,891	78,285
Trinidad	129,811	435,093	487,521
British Guiana	35,490	163,504	168,898
Other Commonwealth countries	75,533	305,491	442,261
Irish Republic	237,296	1,187,543	879,877
Soviet Union	74,836	1,147,278	607,934
Finland	94,298	560,420	380,837
Sweden	393,284	1,230,534	1,410,771
Norway	210,650	778,175	822,787
Iceland	425	58,338	31,373
Denmark	218,193	667,182	849,395
Poland	24,924	114,312	133,841
Western Germany	172,098	700,508	825,843
Netherlands	659,696	2,304,772	2,773,950
Belgium	322,912	1,080,736	1,300,776
France	235,277	1,211,645	1,491,677
Switzerland	78,826	358,051	456,956
Portugal	283,728	754,385	1,052,528
Spain	552,586	913,960	1,654,632
Italy	285,244	1,230,020	1,227,970
Austria	30,644	172,524	125,954
Yugoslavia	44,642	266,363	230,925
Greece	97,559	892,580	624,757
Turkey	30,244	356,529	206,116
Belgian Congo	49,618	133,474	188,051
Portuguese East Africa	18,284	92,172	112,880
Egypt	37	697,819	853
Libya	25,190	92,418	149,583
Southern Morocco	35,552	177,858	170,254
Sudan	11,083	326,314	330,806
Syria	21 292	212,729	138,831
Lebanon	31,401	188,110	134,904
Israel	56,124	223,281	250,853
Jordan	114,393	191,570	295,740
Saudi Arabia	2,029	282,603	164,683
Iraq	166,640	1,349,887	989,242
Iran	328,658	809,665	1,253,257
Burma	142,595	599,998	287,031
Thailand	108,881	407,347	368,587
Indonesia	19,446	222,170	201,225
Japan	76,486	206,385	309,481
United States	615,157	3,258,803	2,932,645
Cuba	40,991	115,934	161,337
Mexico	46,378	266,217	212,566
Colombia	43,523	389,347	178,247
Venezuela	296,853	1,312,243	1,185,608
Peru	69,272	173,125	272,753
Chile	64,014	91,321	191,503
Brazil	86,263	1,008,300	318,326
Uruguay	17,592	32,275	87,504
Argentine Republic	71,615	261,346	370,851
Other foreign countries	283,450	943,266	1,341,327
TOTAL	17,490,783	71,077,040	74,021,319

from the March figure to £2,799,661, and were slightly below the exports for April, 1956.

In the generating sets, generators, etc., group, India resumed first place as the most important market, purchasing equipment valued at £301,009. Canada continued in second place with a value of £276,251, South Africa being third with £247,898, followed closely by Australia which took apparatus valued at £230,756. India was by far the most important purchaser of converting machinery, mercury-arc rectifiers, etc., taking equipment valued at £665,538. Next in order of importance were Australia with £286,226, and South Africa with £263,700.

The two leading importing countries for radio equipment were Australia, which purchased apparatus valued at £260,893, and Canada, which took equipment of £203,735. Outside the Commonwealth, the principal market was the Netherlands with purchases of £190,085. Australia headed the list in the imports of telegraph and telephone equipment, with a value of £233,910, the next in order of importance being South Africa with £171,991. Although Indian purchases of cables and wires were less than for the preceding month, that country was still the most important buyer, taking goods valued at £502,923.



The value of imports in the various classes is shown in Table I, while Table II shows their destination. Other electrical items shown in the Board of Trade returns include the following:—

Electrically operated washing machines, complete, not exceeding 150 lb net weight: April, £319,625; four months, £1,264,097. Ditto, 150-250 lb net weight: April, £105,179; four months, £425,932. Parts: April, £49,557; four months, £226,843.

Electric carbons, including parts: April, £42,737; four months, £218,590.

Welding electrodes (excluding carbon), covered: April, £119,883; four months, £481,914.

Electric conduit tubes and cased tubes: April, £71,667; four months, £356,324.

Electric locomotives: April, £542,816; four months, £1,475,720.

Electrical Imports

Imports of electrical machinery and apparatus, which have recently been declining, rose last month to £2,382,905, as compared with £1,865,761 for March and £1,910,562 for April, 1956. The total for the first four months of this year was £8,476,531, as compared with £8,061,836 for January-April, 1956. The United States continued as the principal supplier with imports valued at £861,352. Western Germany was again second with goods valued at £360,175, and the Netherlands third with £340,006. As for some time past, radio and associated equipment was the principal class of imports.

GENERATION AND DEVELOPMENT

Bulk Supply Tariff Increase Criticised

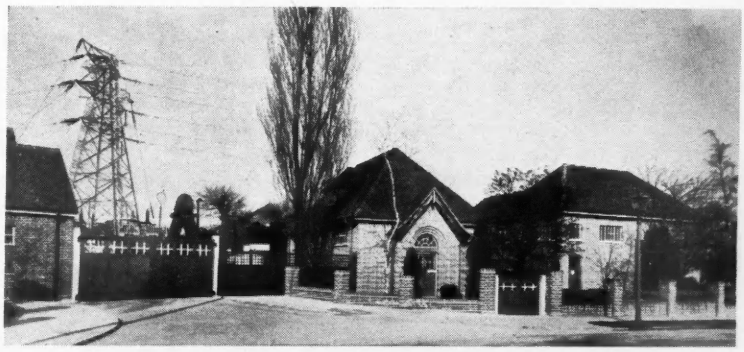
In a resolution passed at its last meeting the Yorkshire Electricity Consultative Council "strongly deprecated the action of the Central Electricity Authority in raising the bulk supply tariff without giving adequate notice." The Council suggested that in view of the impending reorganisation of the electricity supply industry and of the disastrous effect upon the Yorkshire Board's tariff, which had just been increased as from 1st April, the C.E.A. should consider withdrawing the increase of 10s per kW which was to come into force in October.

The Council was informed that the Board had anticipated that the bulk supply tariff for the whole year would be £5 10s per kW. The extra increase of 10s in the second six months meant an additional cost to the Board of some £1,000,000 in a full year, and the Board therefore intimated that it would have to review the tariffs at the end of the current financial year.

Alderman Leach, chairman of the Consultative Council, recalled that in December last the Board had submitted proposals for increased tariffs which the Council accepted on 13th February. The chairman of the Board had then given an assurance that, given anything like normal conditions, the Board could reasonably expect to hold these tariffs for a minimum of two years from the date of operation. Now, however, they were faced with further increases next year.

Boards' Sales in April

Details of the output of electricity in April were given in last week's issue. The accompanying table analyses the sales in that month of the twelve Electricity Boards in England and Wales. The national figures show an increase over April, 1956, of 2·2 per cent, but when corrected for weather conditions and working days, the increase is 5·3 per cent.



Situated in a residential area, the Harrow grid substation building housing the new 33 kV switchgear and control room has been designed to conform with the surroundings. Small areas of lawn and garden are being laid out in front

Harrow Grid Substation

To meet increasing demands in the Harrow and Northwood Districts of the Eastern Electricity Board, the supply at the Harrow grid substation is now being taken from the Central Electricity Authority's 132 kV system via two 90 MVA, 132/33 kV transformers. These are connected to the four existing 33/11 kV transformers which were formerly supplied by Taylors Lane generating station, and serve local 11 kV substations in the two districts, while five 33 kV feeders go to more remote substations in the Northmet and Chilterns Sub-Areas.

A new 12-panel, 33 kV, single busbar 750 MVA switchboard, relay board and control board at the substation have been supplied by the General Electric Co., Ltd. The switchgear is of the company's metalclad type, with vertical isolation, and the two units controlling the 90 MVA transformers have the unusually high rating for 33 kV gear of 1,600 A. Discrepancy switches on the control board mimic diagram provide operation and indication of the switchgear and indication of when a unit is isolated and earthed.

The project was engineered and the building designed by the staff of the Eastern Electricity Board.

New Scottish Nuclear Station Inquiry

The second inquiry into the South of Scotland Electricity Board's proposal to build a nuclear power station at Hunterston, it is now announced, will open on 4th June in Barrfields Pavilion, Largs, where the first inquiry was held earlier this year by the late Sir Randall Philip, Q.C. The hearing is expected to be completed in not more than a week. As already announced, it will be conducted by Mr. H. R. Leslie, Q.C.

Purchase Tax Representations

Purchase tax on domestic appliances was among the subjects discussed at the last meeting of the Southern Electricity Consultative Council, held at Reading on 22nd May. It was noted that though concessions had been made in respect of many other household articles, purchase tax was still retained on electric kettles, an essential item in so many houses to-day. The Council agreed to make representations to the Chancellor of the Exchequer.

Railway Station Lighting

The conversion of the lighting system at Chinley Railway Station, Derbyshire, from gas to electricity is estimated to cost £14,000. The contract for the work has been placed with C. A. Newton & Co., Ltd., of Derby.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for April (million kWh)			Twelve Months' Totals Ended 30th April (million kWh)		
	1956	1957	Inc. or Dec. %	1956	1957	Inc. or Dec. %
London	572·4	560·0	− 2·2	6,792·9	6,853·6	+ 0·9
South Eastern	361·7	363·4	+ 0·5	4,228·2	4,405·5	+ 4·2
Southern	424·0	441·4	+ 4·1	5,068·9	5,431·9	+ 7·2
South Western	215·4	229·7	+ 6·6	2,590·8	2,750·4	+ 6·2
Eastern	569·3	580·1	+ 1·9	6,740·1	7,083·3	+ 5·1
East Midlands*	481·6	495·8	+ 2·9	5,794·6	6,068·2	+ 4·7
Midlands*	622·3	629·3	+ 1·1	7,594·0	7,714·6	+ 1·6
South Wales*	361·5	380·3	+ 5·2	4,411·6	4,564·7	+ 3·5
Merseyside and North Wales*	378·5	386·1	+ 2·0	4,523·4	4,758·3	+ 5·2
Yorkshire*	623·0	647·2	+ 3·9	7,540·6	7,900·4	+ 4·8
North Eastern*	368·2	381·4	+ 3·6	4,329·4	4,557·2	+ 5·3
North Western*	659·1	659·4	0·0	8,023·6	8,239·8	+ 2·7
Total all Area Boards	5,637·0	5,754·1	+ 2·1	67,638·1	70,327·9	+ 4·0
Direct Supplies by Central Authority	174·2	187·3	+ 7·5	2,015·3	2,238·7	+11·1
Grand Total	5,811·2	5,941·4	+ 2·2	69,653·4	72,566·6	+ 4·2
Mainly Industrial Areas*	3,494·2	3,579·5	+ 2·4	42,217·2	43,803·2	+ 3·8
Mainly Non-Industrial Areas	2,142·8	2,174·6	+ 1·5	25,420·9	26,524·7	+ 4·3

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

NEW ELECTRICAL EQUIPMENT

A New Assay Furnace

A "Globar" type assay furnace now available from ROYCE ELECTRIC FURNACES, LTD., of Sir Richard's Bridge, Walton-on-Thames, Surrey, promises to have many applications not only in the mining and metallurgical industries but also wherever a self-contained source of high temperature treatment is required, as for example in the electrical and electronic industries, in tool treatment, etc.

These furnaces are specially designed for fusing and cupellation. The silicon carbide rod resistor heating elements are suitable for service temperatures of up to 1,350 deg C and they ensure a long operational life for assaying gold at 1,050 deg C or copper at 1,150 deg C. A transformer with voltage adjustment taps is provided to control the electrical input for temperature control and resistance regulation.

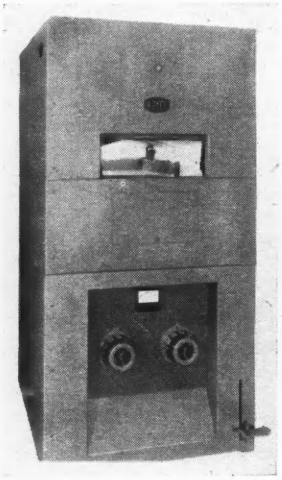
Electrical ratings for a range of standard sizes are alternatively 9, 12 or 15 kW and overall dimensions are typically 3ft 7in by 3ft by 6ft 4½in. Non-standard units are manufactured to individual requirements.

Radiant Heater

A 3 kW radiant space heater introduced by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17, consists of an aluminium reflector, tubular metal sheathed heating element, stainless steel element supports, reflector support bracket of mild steel phosphated and finished in heat resisting paint, and a die-cast aluminium alloy weatherproof terminal box. The element ends have special weatherproof seals with screwed terminals and are themselves sealed into the terminal box with silicone rubber bushes. The terminal box cover is provided with a butyl rubber gasket and is secured by a single fixing screw.

Its very low weight (5 lb) simplifies the supporting arrangement and enables the heater to be mounted from the terminal box by means of a single 1in diameter conduit. A fixing bracket permitting angular adjustment in one plane is available as an optional extra. The element has a robust tubular outer sheathing of non-corrodible alloy, enclosing the heating spiral which is insulated by highly compacted magnesium oxide. The price of the heater is £8 10s for various single-phase supply voltages between 200 and 250.

Royce assay furnace



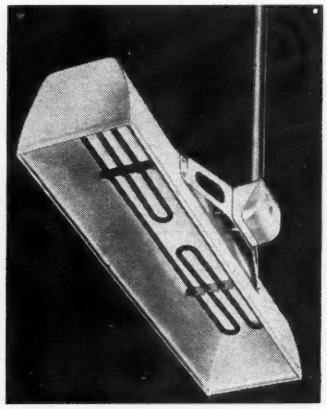
Battery Floor-Cleaning Machines

An additional range of battery powered floor cleaning equipment has just been introduced by DIAMOND MOTORS (WOLVERHAMPTON), LTD., Upper Villiers Street, Wolverhampton. Known as the "Mechocleen" range, it comprises three machines: a dry scrubber/polisher, a wet/dry scrubber/polisher and a dryer. The two scrubbing machines can be adapted to clean any type of floor simply by changing brushes, an operation which can be carried out in one minute.

Both the dry scrubber/polisher and the dry/wet scrubber/polisher are constructed so that the scrubber unit, consisting of the brushes, a ¾ h.p. electric motor, transporter wheels and handlebar, can be separated from the battery cradle and castors.

Each battery cradle holds a 72 Ah "Exide" traction battery and is equipped with two castor wheels fitted just to the rear of the machine's centre of gravity so that the operator can manœuvre it with ease and swing it round in its own length.

The wet scrubber has a 4½ gal capacity tank mounted on the handlebar upright and a variable feed control. To ensure long life and minimum maintenance, an aluminium dust cover is used on the gears between the electric motor and the brushes, and polyester fibreglass mouldings cover the motor unit and the switch mechanism. This material is knock-resistant and is self-coloured all through.



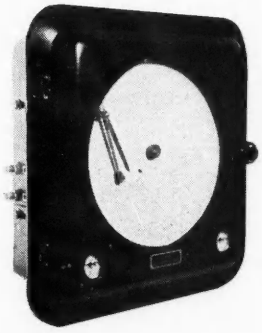
Metrovick 3 kW radiant space heater

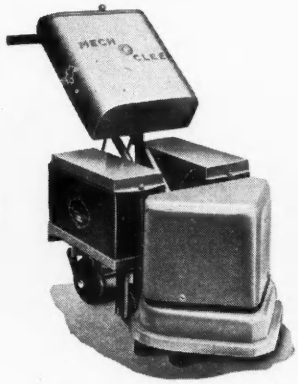
Temperature Recorder/Controller

A new range of self-balancing indicator/recorder controllers, designed for the measurement of industrial or laboratory temperatures and giving potentiometric accuracy reproducible to approximately 0·2 per cent full scale, has just been introduced by FIELDEN ELECTRONICS, LTD., Wythenshawe, Manchester, 22. They can be supplied for any range span greater than 20 deg C between −200 deg C and +500 deg C as single point and as four point recorders. An additional indicating scale approximately 11in in diameter can also be fitted to the single point model.

The ample servo-power available overcomes friction and provides the

Fielden Electronics single point recorder/controller resistance thermometer





"Mechocleen" battery powered dry/wet scrubber/polisher

torque to operate electrical on/off controllers or pneumatic controllers. All models of the instrument are housed in a standard case the design of which is independent of the range coverage.

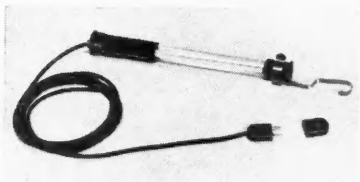
To ease the usual problem of routine maintenance and service the complete electronic chassis is not calibrated. It is plugged into the main assembly and all chassis are completely interchangeable.

The bridge circuit employed is fed with a.c. voltage and no stabilised d.c. source is required, neither is there any need for recalibration or standardisation when the instrument is in use. The simple plug-in type electronic chassis can easily be changed if required, and again there is no need for recalibration.

The resistance elements used are platinum resistance bulbs with good stability and are fully interchangeable in the majority of ranges. A comprehensive range of chart speeds and standard temperature scales is available.

Fluorescent Inspection Lamp

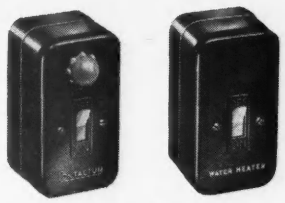
A new type of inspection lamp, the "Wanderlight," which in addition to the usual applications is especially suitable for use in confined spaces and close work, has been introduced by LONGLAMPS, LTD., 24, Marshalsea Road, London, S.E.1. Two models are available, 12in and 15in, using 9in 6 W and 12in 8 W fluorescent daylight tubes, respectively. An anti-glare shield is fitted. Ballasting is accomplished by a specially designed length of resistance cable. The length of the cable can be increased by means of an extension socket. The lamp is enclosed in a toughened acetate tube, measuring 1¼in in diameter, and the handle is of p.v.c. A suspension clip is provided and the prices are £2 9s 6d 12in) and £2 19s 6d (15in).



Longlamps "Wanderlight" fluorescent inspection lamp

Water Heater Switches

A new range of 30 A d.p., a.c. surface switches, primarily designed for water heaters, are now available from CONTACTUM, LTD., Victoria Works, Edgware Road, London, N.W.2. They are also equally useful for any 15-30 A requirement where a good capacity margin is desired. They may be obtained with or without a neon pilot light and have top, bottom and back cable entry for either surface or sunk wiring. Solid block type brass terminals with twin connection screws



Contactum 30 A water heater switches

are employed and the terminals are conveniently placed for straight through wiring. The list prices per dozen, in brown Bakelite, are:—List No. 3001, without pilot light, £4 4s; 3002, without pilot light and complete with flash box, £5 4s; 3003, with pilot light and complete with flash box, £7 16s. In white Bakelite the switches are 12s per dozen extra. Switches engraved with the words "Water Heater" can be supplied at 4s per dozen extra.

Motor Control Gear

A new range of medium voltage a.c. motor control gear switchboards, designated the "G" range, is now in full production by the BELMOS CO., LTD., of Bellshill, Lanarkshire. This compact design in four and five tiers is most useful where a number of standard direct-on-line starters for three-phase motors are best grouped together as a switchboard, with either local or remote control.

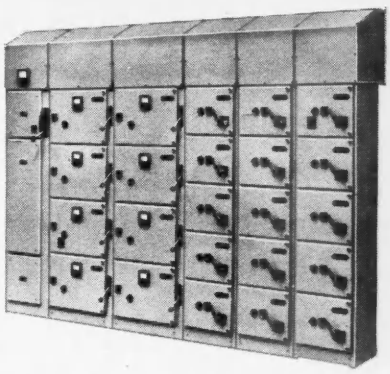
The space saved is 20 to 30 per cent compared with a two or three tier construction. Further space can be saved by using the design which permits the switchboards to be mounted directly against a wall.

Individual isolation and back-up h.r.c. fuse protection are provided as standard, and other features which can be added include ammeter, indicating lamps, 110 V control circuit, and sequence interlock between starters. Already several installations, each involving over 250 starters, have been supplied for new continuous process plants.

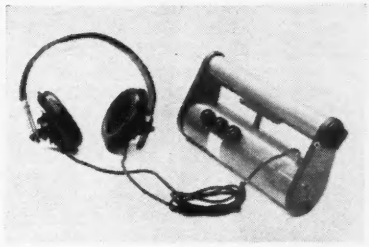
A choice of five stove-enamelled colours is offered as the standard finish. The five tier cubicles accommodate direct-switching starters up to 12½ h.p. at 440 V, and the four tier up to 40 h.p. (and occasionally up to 70 h.p.). When larger horse-powers or multi-step starters are also involved, housings of one or two tiers can be supplied to match. A new leaflet, reference K 450, describes and illustrates this new development in some detail.

Metal Detector

A portable lightweight metal detector, incorporating transistors, is offered by METAL DETECTION, LTD., Moseley Street, Birmingham, 12. The equipment, named the "Transitect," comprises a hand unit and earphones and weighs only 4 lb. In use it is passed over the surface or object suspected of containing metal and the oscillator volume increases when metal is directly beneath the hand position. The apparatus is simple to operate and can be used for detecting metal-reinforcing in concrete, metal in timber, hidden metal roof supports in mines, etc.



Typical Belmos "against the wall" switchboard with incoming trunking

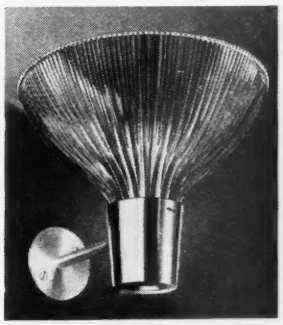


"Transitect" portable metal detector

Lighting Fitting

A new fitting designed for architectural lighting (F.9540) has been introduced by HOLOPHANE, LTD., Elverton Street, Westminster, London, S.W.1. It is a wall-mounting, crystal glass reflector designed to give a semi-indirect lighting distribution and is suitable for use in offices, corridors, foyers, etc.

The prismatic reflector measures 10in at the mouth and the fitting is supplied with a lampholder for a 100 or 150 W lamp. The glass is held in an anodised aluminium alloy cup mounted on a white enamelled bracket, the complete ensemble being of contemporary style.



Holophane F.9540 wall-mounting fitting

Financial Section

STOCKS and SHARES

TOWARDS the end of the past month it appeared that a good many investors were of a mind to accept the advice of the old Stock Exchange maxim which says "sell in May, and go away." Activity subsided and prices of many industrial shares receded appreciably from their recent best, although continuing to show handsome appreciation over quotations ruling in the early part of the year or, for that matter, during most of 1956. In the gilt-edged market, depression of a serious order persisted, carrying War Loan down at one time close to the lowest quotation ever recorded for it. By the beginning of this week, however, signs of resistance were appearing. Company news in the market for electrical equipment shares has been mainly satisfactory.

Mixed Changes

Shares of the principal electrical equipment companies reflected the reactionary trend of the industrial market. G.E.C., Parsons and Reyrolle lost a further shilling or so. Mixed movements took place among heavy engineering shares. Simon-Carves and W. H. Allen (with the final dividend due shortly) again improved, reaching their best prices of the year, but Babcock & Wilcox lost half a crown, Clarke Chapman reverted to about 170s after touching 180s, and Thornycroft were marked down sharply to 31s 3d after the announcement of a reduced interim dividend. Allen West were firm at 16s 9d (after being 17s 3d), on the strength of the progressive character of the annual report. Marryat & Scott improved again, to 11s 6d. Reliance Clifton 5s shares were quoted at 11s 6d following the announcement of increased earnings, and now show a yield of approximately 6 per cent on the basis of the well covered dividend of 13½ per cent. Veritys are also maintaining their dividend, at 12½ per cent as before, from higher earnings.

Ever Ready Results

The 5s shares of Ever Ready (Great Britain) had moved up from 31s 9d to 37s during the first part of the month in anticipation of good annual results, and hardened further to 38s when these were announced, together with the proposal for a one-for-one scrip issue. A moderate improvement in the net profit to £893,000, after tax, was regarded in the market as a sound achievement in the difficult circumstances prevailing for much of the year ended last March. An increase in the total dividend from 35 to 37½ per cent well fulfilled expectations, and a scrip issue announcement always gets a good market reception these days. On the basis of the new rate of dividend, which is covered better than 2½ times by earnings, the yield on the shares becomes a fraction under 5 per cent.

Brush and Hawkers

Holders of Brush Group shares have until 7th June to notify acceptance of the conditional invitation to exchange

Price Changes in

Company or Board	Nom. Value	Middle price 27th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1957 Highest	1957 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	73½	−1	3	3	4 1 9	80	73½
Brit. Elec. 1974/77	100	71½	−1	3	3	4 4 0	78½	71½
Brit. Elec. 1976/79	100	75½	−1	3½	3½	4 12 9	81½	75½
Brit. Elec. 1974/79	100	86½	−1	4¼	4¼	4 18 3	92½	86½
Overseas Electric Supply								
Calcutta Elec.	£1	17/6	−6d	6†	6†	6 17 3†	19/-	17/6
East African Power	£1	19/6	−1/-	7	7	7 3 6	21/-	19/3
Nigerian Elec.	£1	17/6		10	10*	11 8 6	18/6	17/3
Perak Hydro-Elec.	£1	17/6		10	10*	11 8 6	17/6	13/3
Electrical Shares								
Aberdare Cables	5/-	12/6		17½	17½	7 0 0	12/6	9/9
Aerialite	1/-	5/9	−3d	45	48	8 6 9	6/-	4/9
Allen, W. H.	£1	45/9	+1/3	20	10*	4 7 6	45/9	33/6
Anglo-Portuguese Tel.	£1	25/9		8	8	6 4 3	27/6	20/6
Aron Elec. Ord.	£1	56/3		15	15	5 6 9	56/3	53/6
Assd. Automation	10/-	22/9	−2/-	5	7½	3 6 0	24/9	17/9
Assoc. Elec. Ord.	£1	66/3	−1/3	15	15	4 10 6	73/-	62/6
Automatic Tel. & El.	£1	72/6		15	17	4 13 9	72/6	54/6
Babcock & Wilcox	£1	72/6	−2/6	15	15	4 2 9	82/6	71/6
Bakelite	10/-	24/6		16	15	6 2 6	24/6	20/9
Baldwin, H. J.	2/-	4/-		20	20	10 0 0	5/-	4/-
Berry's Electric	5/-	6/-	−3d	—	10‡	8 6 9	6/3	5/6
British Aluminium	£1	66/3	−3/9	12	12	3 12 6	71/3	63/9
Brit. Elec. Traction: Def. Ord. "A"	5/-	21/6	−9d	22½	22½	5 4 9	22/3	17/-
B.I. Callender's	£1	50/6	−1/3	12½	12½	4 17 6	55/-	48/3
B.I. Callender's 6% Pref.	£1	21/-		6	6	5 14 3	21/9	20/6
British Tabulating	£1	55/9	−6d	9	9	3 4 6	56/3	42/-
British Thermostat	5/-	26/3	−9d	25	25	4 15 3	27/6	25/9
British Vac. Cleaner	5/-	7/-	+9d	15	10	7 2 9	8/-	6/6
Brook Motors	10/-	36/3		25	15	6 18 0	36/3	30/-
Brush Group	5/-	7/9	−3d	10	Nil	—	8/-	4/6
Bulgin, A. F.	1/-	5/-		50	40*	8 0 0	5/6	4/6
Burco Dean	5/-	12/6		22½	20	8 0 0	13/-	8/9
Cable & Wireless: Ord.	5/-	11/6	−3d	10	10	4 7 0	12/-	9/6
4% Loan	100	92½		4	4	4 6 6	92½	89
Chloride El. Storage "A"	£1	68/9		17½	17½	5 1 9	68/9	58/-
Clarke Chapman	£1	170/-		22½	27½	3 4 9	8⅞	6¼
Cole, E. K.	5/-	23/3		17½	17½	3 15 3	23/3	16/6
Cossor, A. C.	5/-	6/-		15	Nil	Nil	7/3	5/9
Crabtree	10/-	25/6		20	20	7 16 9	25/6	23/3
Crompton Parkinson Ord.	5/-	16/6		16	16	4 17 0	17/9	14/6
De La Rue	5/-	19/9	−9d	30	30	7 12 0	20/6	16/3
Decca "A"	4/-	27/6	−6d	43¾	43¾	6 7 3	32/3	27/-
Desoutter	5/-	33/6		30	32½	4 17 0	33/6	27/6
Dewhurst	2/-	7/-		30	16½*	4 12 9	7/6	5/9
Dictograph Tel.	2/-	7/9		20	20	5 3 3	7/9	6/9
Dubilier Condenser	1/-	5/9		25	30	5 4 3	5/9	5/6
Duport	5/-	18/9	−3d	23	25	6 13 3	19/6	17/6
E.M.I.	10/-	32/6		15	15	4 12 3	33/3	23/9
Electrical Components	5/-	7/6		25	25	8 6 9*	7/6	6/6
Elec. Construction	£1	27/6		8½	8½	6 3 9	27/6	21/9
Elliott Bros.	5/-	29/9		17½	20	3 7 3	29/9	26/3
Enfield Cable Ord.	£1	15/-		Nil	Nil	Nil	21/6	13/-
English Electric	£1	58/9		12½	14	4 15 3	60/-	47/6
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/3	13/-
Ericsson Tel.	5/-	46/-		20†	22†	2 7 9†	46/-	33/3
Ever Ready	5/-	38/-	+1/3	35	37½	4 18 9	38/-	30/-
Falk Stadelmann	£1	40/3	−3d	17½	17½	8 14 0	40/6	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

into the shares of the Hawker Siddeley Group. From all reports, few of them are finding any difficulty in making up their minds about the acceptability of the offer. The main reasons for the directors' recommendation of acceptance have been set out in a circular. Apart from financial and technical considerations, there is the inducement that the Hawker ordinary shares issued in exchange will qualify for the full 10 per cent dividend expected for the current year. Brush 5s ordinary shares, of which five would be exchanged for one Hawker £1 share, have been quoted lately at 7s 9d, while Hawkers have been 38s 9d.

Electrical Investments

Company or Board	Nom. Value	Middle price 27th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1957 Highest	1957 Lowest
Electrical Shares—continued								
G.E.C. Ord.	£1	57/6	−1/3	12½	14	4 17 3	58/9	48/9
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/6	22/-
General Cables	5/-	13/9	+1/-	30	30	10 18 3	13/9	11/6
Greenwood & Batley	£1	47/6		17½	17½	7 7 3	47/6	45/3
Hackbridge Holdings	5/-	21/3		25	30	7 1 3	21/9	19/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	16/-	13/6
Head Wrightson	£1	137/6		20	22½	3 5 6	137/6	112/6
Heatrae	2/-	4/6		15	15	6 13 3	4/6	4/-
Henley's	10/-	15/3	−6d	11½	11½	7 10 9	17/-	15/3
Holophane	5/-	26/3		30	30	5 14 3	26/3	17/-
Hoover	5/-	39/-	−6d	50	50	6 8 3	39/6	24/9
I.C.I.	£1	44/9	−1/-	10	10	4 9 6	46/6	37/9
Intl. Combustion	5/-	27/6	−1/3	20	22½	4 1 9	30/-	20/-
Johnson & Phillips	£1	28/-	−2/-	15	10	7 2 9	34/6	28/-
Lancashire Dynamo	£1	45/-	+1/3	11	11	4 17 9	45/-	36/9
Laurence, Scott	5/-	19/3		15	15	—	19/9	13/9
Lister, R.A.	£1	33/9	+2/-	9·3	10	5 18 6	33/9	26/9
London Elec. Wire	£1	50/-	−6d	12½	12½	5 0 0	53/9	43/-
Lucas, J.	£1	35/9	−9d	7½	7½	4 4 0	36/6	30/6
Marconi Marine	£1	33/9		10	10	5 18 6	33/9	31/-
Marryat & Scott	2/-	11/6	+9d	30	30	5 4 3	11/6	8/-
Mather & Platt	£1	62/6	+1/3	15	15	4 16 0	62/6	51/3
Metal Industries	£1	25/6		9	Nil	—	26/3	20/3
Midland Elec. Mfg.	£1	48/9		12½	12½	5 2 6	48/9	45/-
Morphy-Richards	4/-	17/-	−3d	50	50	4 14 3*	17/3	11/9
Murex	£1	77/-	−6d	20	20	5 4 0	77/6	65/-
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	2/6	2/3
Parnall (Yate)	5/-	8/3		12	12	7 5 6	8/9	5/9
Parsons, C. A.	£1	66/3	−1/3	10	8½*	—	71/3	50/6
Plessey	10/-	83/-	−1/-	27½	30	3 12 3	84/9	61/-
Pye "A" Deferred	5/-	20/-		12½	12½	3 2 6	20/-	15/9
Reyrolle	£1	100/-	−1/3	16⅛	17½	3 10 0	110/-	90/-
Rheostatic	4/-	10/-		18½	12½*	5 0 0	10/-	8/9
Richardsons Westgarth	5/-	19/9	−3d	16⅔	16⅔	4 4 6	20/-	17/-
Scottish Cables	4/-	17/9	−6d	27½	27½	6 4 0	19/3	15/-
Simon-Carves	5/-	32/-	+9d	28⅓	20*	3 2 6	32/-	26/-
Smith (England), S.	4/-	15/9		17½	17½	4 9 0	15/9	13/-
Southern Areas	£1	18/9		7½	7½	8 0 0	20/-	13/9
Strand Elec.	5/-	7/9	+6d	15	15	9 13 6	8/-	7/3
Sturtevant	5/-	25/9		15†	15†	2 18 3†	27/-	24/3
Sun Elec.	£1	43/9		20	25	11 8 6	43/9	43/9
Switchgear & Cowans	5/-	14/3	−9d	25	25	8 15 6	15/6	13/6
Taylor Tunnicliff	5/-	13/3		15	15	5 13 3	13/9	11/9
T.C.C.	10/-	40/-		25	25	6 5 0	40/-	35/-
T.C. & M.	£1	26/3	−2/3	8½	8½	6 9 6	31/-	24/6
Telephone Mfg.	5/-	7/6	−6d	10	10*	6 13 3	8/-	6/3
Telephone Rentals	5/-	12/3		12½	12½	5 2 0	12/6	10/3
Thompson (John)	5/-	33/3	−1/-	25	25	3 15 3	37/-	29/3
Thorn Elec.	5/-	23/9	−2/-	15	15	3 3 3	26/3	16/3
Thornycroft	£1	31/3	−4/3	15	12½	8 0 0	37/6	31/3
Tube Investments	£1	65/-	−3/-	22½	15*‡	4 12 3	68/9	58/3
Vactric	5/-	23/9	+9d	15	17½*	3 13 9	23/9	12/9
Veritys	5/-	9/-		12½	12½	6 19 0	9/3	8/3
Walsall Conduits	4/-	15/-		70	20*	5 6 9	15/-	11/-
Ward & Goldstone	5/-	53/9	−1/3	30	35	3 5 0	56/3	36/9
Watford	2/-	6/6		25	25	7 13 9	6/9	6/3
Westinghouse	£1	40/-		18	9‡	4 10 0	41/3	36/-
West, Allen	5/-	16/9		15	15	4 9 6	17/3	12/3
Wolf Electric	5/-	12/6	−1/-	20	20	4 0 0*	13/6	8/9

John Thompson Issue

An issue of just over a million 5s ordinary shares is to be offered to shareholders of John Thompson on the basis of one new share, at a price of 25s, for every three at present held. This proposal is included with the preliminary announcement of the company's results for 1956, the features of which are the 20 per cent expansion in group profits to over £2½ million, and the maintenance of the dividend at a total of 25 per cent, as before. The dividend involves the distribution of less than one-third of the year's net surplus, and in the normal course of events the directors expect to be able to pay the same rate on capital as enlarged by the share issue. The latter is needed partly in connection with the atomic power station projects entrusted to the A.E.I.–John Thompson Nuclear Energy Co. With the existing 5s shares quoted at 33s 3d, the "rights" are worth some 2s per share.

English Electric Issues

Tuesday of this week was the last day for acceptances of the English Electric Co.'s "rights" offer of just over 3 million ordinary shares at 50s per share. Dealings are in progress in the £9 million issue of 5½ per cent debenture stock, redeemable 1977–82. This encountered conditions rendered very inhospitable by the persistent depression of the gilt-edged market, with the result that rather less than half the amount offered was taken up by shareholders, and the stock has been quoted at a discount of about a point on the issue price of 97. It is at present £25 per cent paid, and transferable free of stamp duty. At an all-in price of 96 the buyer secures a yield of nearly 5¾ per cent.

Automation and Electronics

Yields of less than 3½ per cent from the ordinary shares of Elliott Brothers and Associated Automation, on the basis of the dividends recently declared for 1956 by both companies, witness the confidence which investors feel in the future of automation, electronics and associated activities. Elliott Brothers paid for last year a 10 per cent interim dividend, followed by a final at the same rate on capital increased by the subsequent acquisition of the share capital of Associated Insulation Products. Profits of the Automation group rose by about 12 per cent to £293,000 (before tax), while a profit of £273,000 was earned by the A.I.P. company. Referring to prospects in general, the report indicates that the long-term plans of the group are maturing in the manner hoped for. Associated Automation is paying a dividend of 7½ per cent on capital doubled by the issue of shares made at the time of the acquisition of the Electroflo business. Last year's payment was 5 per cent.

REPORTS and DIVIDENDS

John Thompson, Ltd.—The group profits for 1956 amount to £2,550,961, as compared with £2,113,866 for 1955, and after meeting all charges, including £1,208,444 for taxation, the net balance is £939,049 (against £752,667). It is proposed to pay a final dividend of 15 per cent, again making 25 per cent for the year. Treasury consent has been obtained for a rights issue on the basis of one new 5s ordinary share at 25s for every seven held. The issue of 1,048,227 ordinary shares will raise approximately £1·3 million which will enable the company to fulfil its new commitments for the nuclear energy programme and provide additional working capital to finance the increase in turnover. It is stated that the directors expect that the current year's earnings will be sufficient to maintain the dividend rate on the increased capital. Work to be undertaken by the company in connection with atomic energy projects will have a value of between £9 million and £10 million. This work is to some extent additional to the company's normal business, the turnover of which, it is stated, has increased by over 70 per cent in the last four years.

Elliott Brothers (London), Ltd.—The accounts for 1956 now issued confirm the preliminary figures given in our issue of 3rd May. In his statement which accompanies the report and accounts, Mr. R. E. F. de Trafford (chairman) says that the year has been one of further progress for the automation group, the turnover of which has again increased. The order book has continued to expand and is spread over the wide range of their activities. Their nucleonic division is engaged on contracts for the instrumentation of nuclear power stations and has been entrusted by Vickers Nuclear Engineering, Ltd., with the design and construction of the control systems and instrumentation for the nuclear-powered submarine *Dreadnought*.

The Power Securities Corporation, Ltd.—In the course of his review of 1956, Sir Andrew M. MacTaggart (chairman and managing director) says that Balfour Beatty & Co., Ltd., the principal subsidiary company, continues to hold a leading position in civil and electrical engineering contracting, both at home and abroad. The first section of the Staythorpe power station, which they are constructing for the C.E.A., was completed during the year. Work on the second section was deferred for some months by the Authority, but commenced recently and is now proceeding normally. The Carmarthen Bay power station went into commission during the year.

The Transmission Line Department erected some 550 miles of h.v. lines and 170 miles of l.v. lines in the United Kingdom. They still have in hand for the C.E.A., the North of Scotland Hydro-Electric Board, the South of Scotland Electricity Board and the East Midlands Electricity Board about 900 miles of h.v. lines, and some hundreds of miles of l.v. lines.

In association with the A.E.I.-John Thompson Nuclear Energy Co. they are taking part in the construction of the Berkeley nuclear power station. In referring to work overseas, Sir Andrew mentions that in Kenya the 250 miles of 132 kV transmission line from Tororo in Uganda to Nairobi for the Kenya Power Co. should be completed well within the estimated period.

The Pulsometer Engineering Co., Ltd.—Addressing the annual meeting held on 17th May, Mr. F. B. Duncan (chairman) said that the small increase in the group profit did not mean that the company's activity had remained at the same level. They had absorbed as far as possible rising costs and used all production economies which they had been able to effect in order to maintain their prices and improve their export position. These actions had enabled them to increase their turnover and in particular their overseas business.

W. Canning & Co., Ltd.—The annual meeting was held on 20th May. In his circulated statement, Sir Ernest R. Canning (chairman) said that total sales during 1956 reached a record level. There was, however, a falling off in sales of plating chemicals and polishing materials. This was due to the recession in certain trades resulting from the "credit squeeze," particularly in the cycle, motor and radio trades. This fall was, however, more than offset by a substantial increase in sales of equipment. With regard to current prospects, there had been some fall in sales of consumable materials during the first months of 1957 but the order book for capital goods was still well filled.

Oriental Telephone & Electric Co., Ltd.—The board has received a proposal for an offer to be made on certain terms and conditions to purchase the whole of the issued stock of the company, or such smaller amount as may be acceptable to the purchaser. The proposal is in effect an alternative to the proposed voluntary liquidation. In its original form, however, the proposal had features which in the opinion of the board were impracticable and furthermore did not appear to confer any balance of advantage on the stockholders. The proposers have now suggested that there should be discussion with the board, after which revised proposals might be made to meet those objections, and in view of this suggestion the board has decided that it would be in the best interests of the stockholders to adjourn the extraordinary general meeting called for 23rd May to give time for further discussion.

Hopkinsons, Ltd.—The annual meeting was held on 23rd May. In his review of the year, Mr. R. L. Brown (chairman and managing director) said that in 1956 they had achieved a high level of output both in value and volume especially for the export markets, but heavy competition abroad, coupled with rising costs, had resulted in a lower ratio of profit. Capital expenditure for the year was £185,829, mainly on plant and equipment to meet the nuclear programme as envisaged at the beginning of the year. Expansion of this programme would necessitate further expenditure both on buildings and plant. Orders received during the year rose by 24 per cent and outstanding orders at the end of the year would provide work for a considerable time ahead. Export orders had grown considerably. With regard to the nuclear power programme, as they were already receiving orders for heat exchanger mountings and valves to equip the first three stations at Bradwell, Berkeley and Hunterston, indications were that this development would necessitate increased production for which they were now making provision. Since the end of the year they had purchased a controlling interest in Fielden Electronics, Ltd.

The Ever Ready Co. (Great Britain), Ltd., reports a group profit, before taxation, of £1,797,810 for the year to 2nd March last, as compared with £1,749,743 for 1955-56, and after deducting £905,186 for taxation, the net balance is £892,624 (against £878,720). It is proposed to pay a final dividend of 27½ per cent, making 37½ per cent for the year (against 35 per cent). It is also proposed to capitalise £1,515,603 of reserves to make a free scrip issue of one ordinary 5s unit for every ordinary 5s unit held. Treasury consent has been obtained.

The Engineering & Lighting Equipment, Ltd., reports that after providing for taxation, the net profit for the year to 31st March last is £41,065, as compared with £50,864 for the preceding year. The dividend for the year is maintained at 20 per cent, with a final payment of 15 per cent.

Allen West & Co., Ltd., report a consolidated trading profit for the year to 31st January last of £1,285,245, as compared with £1,094,296 for the preceding year. After meeting all charges, including £519,824 for taxation, the net balance is £499,401 (against £454,741). General reserve receives £330,000 and it is proposed to pay a dividend for the year of 15 per cent (unchanged). The balance carried forward is £157,415 (against £139,383 brought in).

In his statement Mr. M. W. H.

Lancaster (chairman) says that the South African company continues its excellent trading record and the Rhodesian company which commenced operations in February, 1956, has been successful in making a profit in its first year.

The Telephone Manufacturing Co., Ltd.—The group profit for 1956 was £117,134, as compared with £146,228 for 1955. Taxation absorbed £154,961. The dividend for the year is maintained at 10 per cent, with a final payment of 7½ per cent.

The English Electric Co., Ltd.—Lazard Bros. & Co., Ltd., announces that allotment letters in respect of applications for the £9 million 5½ per cent debenture stock, 1977-82, have been posted. Underwriters will be required to take up approximately 55 per cent of the issue.

Louis G. Ford, Ltd.—The consolidated profits for 1956 amount to £149,538, as compared with £157,532 for 1955. Taxation requires £79,923, and the net profit is £69,615 (against £73,042). It is proposed to pay a final ordinary dividend of 10 per cent, making 15 per cent for the year, and to carry forward £90,525 (against £66,002 brought in). In his statement, Mr. L. G. Ford (chairman) says that the parent company and the subsidiary, Ford Wholesale Electric, Ltd., not only maintained but increased their volume of trade, but the additional trading profit on increased turnover was more than offset by slightly lower profit margins and by increased expenses.

Veritys, Ltd.—The trading profits for the year ended 31st December last amount to £61,651, as compared with £54,880 for 1955. After deducting £10,453 for depreciation and £29,442 for taxation, the net balance is £21,756. It is proposed to maintain the dividend for the year at 12½ per cent, to transfer £8,500 to general reserve and to carry forward £33,340 (against £33,021 brought in).

John I. Thornycroft & Co., Ltd., has announced an interim dividend of 3½ per cent (against 5 per cent).

The Calcutta Electric Supply Corporation, Ltd., has announced a second interim dividend of 3 per cent, tax free.

New Companies

Kerry's (Ultrasonics), Ltd.—Registered 2nd May. Capital £15,000. Mechanical, precision, electrical, radio and television engineers, and the application of ultrasonics to all forms of engineering, etc. First directors: Edward C. Elliott and Walter N. Hart. Solicitors: Ernest G. Scott & Co., 31-2, Broad Street Avenue, E.C.2.

Wyer & Sutherland, Ltd.—Registered 2nd May. Capital £3,000. Electricians, electrical contractors and engineers, mechanical, television and radio engineers, etc. Directors: Ernest W. Wyer and Derrick B. Sutherland. Secretary: E. W. Wyer. Regd. office: 22, Greevegate, Hunstanton, Norfolk.

Liquidations

W. E. Partridge (Electrical), Ltd.—Particulars of claims to the liquidator, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3, by 18th June.

Ryhope Electrix, Ltd.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, appointed 14th May.

Bankruptcies

A. Banoff (trading as Almyn Radio Electric Co.), lately carrying on business at 111, Church Road, Hove, Sussex, electrical and radio engineer.—Trustee, Mr. H. C. Hedges, 4, Charterhouse Square, London, E.C.1, appointed 15th May.

G. B. Solomon, 57, Fore Street, St. Columb, Cornwall, trading as St. Columb Radio, radio and electrical dealer.—Trustee, Mr. E. J. Ellis, 50, The Terrace, Torquay, appointed 15th May.

H. Rose, 158, Soho Road, Handsworth, Birmingham, trading as Rose Electrical Service, electrical contractor.—Last day for receiving proofs for dividend 1st June. Trustee, Mr. W. H. Haigh, Somerset House, 37, Temple Street, Birmingham, 2.

T. Blackburn, 44, Bournemouth Road, Folkestone, electrical engineer.—Receiving order made 14th May on a creditor's petition.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged.

Monday, 3rd June

LEEDS.—Great Northern Hotel, 7 p.m. A.S.E.E. Leeds Branch. Annual general meeting.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. Annual general meeting.

WEMBLEY PARK.—Century Hotel, Forty Avenue, 7.30 p.m. A.S.E.E. North West London Branch. Annual general meeting.

Monday, 3rd June, to Friday, 7th June

FOLKESTONE.—Lees Cliff Hall. Electrical Trades Union Conference.

Tuesday, 4th June

BOURNEMOUTH. — Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. "Spot Welding," by C. G. Aldridge.

CARDIFF.—Angel Hotel, Westgate Street, 7 p.m. A.S.E.E. South Wales Branch. Annual general meeting.

HAMMERSMITH.—Windsor Castle Hotel, 134, Kings Street, 7 p.m. A.S.E.E. West London Branch. Annual general meeting.

LONDON. — Great George Street, Westminster, S.W.1, 5.30 p.m. Institution of Civil Engineers. Annual general meeting.

At the Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2, 7 p.m. Incorporated Plant Engineers, London Branch. "The Training of Plant Engineers," by J. Wilson.

LUTON.—Chamber of Commerce, George Street West, 7.30 p.m. A.S.E.E. Luton Branch. Annual general meeting.

MANCHESTER.—Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers, Manchester Branch. "Air Compressor Maintenance and Installation and Ancillary Equipment," by W. McMillan.

WHITERFIELD.—"Eagle and Child," Higher Lane, 7 p.m. Electrical Trades' Commercial Travellers' Association, North Western Branch. Annual bowling match.

YORK. — Royal Station Hotel, 7 p.m. A.S.E.E. York Branch. Annual general meeting.

Wednesday, 5th June

HALIFAX.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. Annual general meeting.

HARRINGAY.—Queen's Head, 677, Green Lanes, N.4, 7.15 p.m. A.S.E.E. North London Branch. Annual general meeting.

MANCHESTER. — Engineers' Club, Albert Square, 7 p.m. A.S.E.E. Manchester Branch. Annual general meeting.

NOTTINGHAM. — Nottingham Mechanics' Institution, Trinity Square, 7.15 p.m. A.S.E.E. Nottingham Branch. Annual general meeting.

PRESTON. — R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. Annual general meeting.

Wednesday, 5th June, to Tuesday, 11th June

YUGOSLAVIA. — Belgrade. World Power Conference Sectional meeting.

Friday, 7th June

CROYDON.—Half Moon Hotel, Broad Green, 7.15 p.m. A.S.E.E. South London Branch. Annual general meeting.

LIVERPOOL.—9, The Temple, 24, Dale Street, 6.30 p.m. A.S.E.E. Liverpool Branch. Annual general meeting.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 8th June:—

No. B732,157 (design). Class 9. High frequency electric switches; apparatus and instruments for use in testing electric circuits and for testing electrical components by the ionisation method; stroboscopes; apparatus and instruments for measuring intervals of time; and electrical apparatus for controlling the operation of oil fired furnaces and for giving warning of their failure.—Cass & Phillip, Ltd., 9, Cavendish Square, W.1.

KEARFOTT (design). No. 751,260. Class 9. Measuring, indicating, calculating and accounting instruments and apparatus; electronic amplifiers, magnetic apparatus for use in the amplification of electric current, electric switches, wave guides; and parts.—Kearfott Co., Inc., Clifton, N.J., U.S.A. Address for service, c/o Stevens Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

CLIK-MEC. No. 757,700. Class 9. Terminal blocks, junction boxes, connectors, plugs and sockets, all for electrical purposes; radio and television aerials, electrical interference suppressors, and high and low frequency electrical apparatus.—Antiference, Ltd., 67, Bryanston Street, London, W.1.

RICOLIT. No. 759,833. Class 9. Electrical apparatus and instruments and parts; and insulated electric cables. — Süddeutsche Isolatorenwerke, G.m.b.H., Freiburg im Breisgan, Western Germany. Address for service, c/o Elkington & Fife, Bank Chambers, 329, High Holborn, London, W.C.1.

Nos. 761,215 and 761,217 (design). Class 9. Cinematographic films prepared for exhibition; television and radio instruments and apparatus; sound reproducing and sound recording instruments and apparatus; and optical projection instruments and apparatus; and parts.—D. C. Thomson & Co., Ltd., Courier Buildings, Albert Square, Dundee.

SPADE CERAMICON. No. 762,512. Class 9. Ceramic electrical condensers.—Erie Resistor, Ltd., 2, Carlisle Road, The Hyde, Hendon, London, N.W.9.

PARLIAMENTARY REPORT

Western Region Railway Plans

Railway modernisation in South Wales was mentioned in an adjournment debate initiated by Mr. Raymond Gower. Replying to his questions about future plans, Mr. Nugent, Parliamentary Secretary, Ministry of Transport, said that diesels would eventually be used universally in the Western Region. They would help particularly in the Severn Tunnel because they would reduce ventilation problems and enable more traffic to go through. Diesel multiple units would be used on the Swansea-Birmingham run, starting on 17th June, and diesels would be progressively brought into use in the rural areas. A new express had been started this year running daily from Birkenhead to Cardiff, connecting North and South Wales via Shrewsbury, Ruabon and Chester—a foretaste of what was to come as diesel-hydraulics were developed in the Western Region.

Farm Electrification

Mr. Kimball said that in his constituency, Gainsborough, many farmers were complaining that they could not get labour for their outlying farms because of the lack of modern amenities and they could get no priority for electricity unless they intended to install a grain dryer. Many of the small farmers did not want grain dryers and in any case could not afford them, but they would like the same priority as was given to supplying electricity to milking sheds.

Mr. Maudling said that in the East Midlands and Yorkshire areas, which were the areas concerned, 85 per cent of the farms had been connected, compared with the national average of 69 per cent. This showed that these Area Boards were aware of the problem, but in individual cases some difficulty remained.

Tokio Criticisms of Calder Hall

Mr. Chetwynd and Wing Commander Bullus asked the Prime Minister what action he proposed to take to counteract the effect on our overseas trade of recent criticism of the British type of reactor.

Mr. Maudling replied for the Prime Minister. He said he had received reports of remarks made about the Calder Hall type of reactor at a conference in Tokio, organised jointly by the American and Japanese Atomic Energy Forum, which were organisations of industrial firms concerned with atomic energy. The reactors at Calder Hall had gone into operation more smoothly and with far less trouble than was normally experienced in starting up a conventional power plant, and the reactor system continued to show great potentialities for further development. They would be glad to show any customers both the limitations and potentialities of Calder Hall, which was the only nuclear power station in the world producing electricity on an industrial scale. The best answer to criticism was to show what we had already achieved—and the critics had not.

Research Studentships

In reply to Mr. Leavey, the Parliamentary Secretary to the Ministry of Works (Mr. Harmar Nicholls) said that 981 D.S.I.R. research studentships were now current, of which 404 were new awards made in the present academic year. In the coming academic year it was expected that about 1,600 studentships would be current: 915 would be new awards, including 200 of the newly introduced advanced course studentships. The increase was partly due to the D.S.I.R. having taken over responsibility for certain awards from the Ministry of Education and the local education authorities. The number of awards for later years was under consideration. He added that the annual cost of these awards was £340,000 in 1956-57 and it would be £445,500 in the current year.

Unemployment in the Radio Industry

Mr. Robert Carr, Parliamentary Secretary, Ministry of Labour, informed Mr. Hunter that at 15th April, 1957, the number unemployed in the radio apparatus and gramophone industry was 1,374, and 399 were unemployed in the radio valve and electric lamp industry. He said it was encouraging to note that the number of unemployed in the radio industry was about 750 less than at this time last year.

Post Office Contracts

Miss Burton asked the Postmaster General whether he was aware of the concern felt in Coventry at the projected cuts in orders given by his Department to the General Electric Co., Coventry.

Mr. Thompson (Assistant Postmaster General) said that the level of orders was at present under review in the light of available capital resources and of stock holdings. Negotiations with the General Electric Co. and other Post Office contractors were in progress, and he regretted that he was not at present able to make a statement about the future.

Miss Burton said this sounded like another death knell for Coventry, which had already suffered badly from the withdrawal of contracts and in other directions. Was the Minister aware that G.E.C. in Coventry was dependent upon the General Post Office and the export market for its orders and if the Post Office cut theirs down the position would be very serious?

Mr. Thompson: We try to avoid undue disruptions in the flow of orders and we shall bear in mind your remarks about this particular company.

Miss Burton referred to an order for telephone instruments given to the G.E.C. last December for completion within twelve months and asked why this period had been extended to 2½ years.

Mr. Thompson replied that a recent review of the stock position made it clear that the projected level of purchases of telephone instruments would be in excess of Post Office needs. Much as he regretted it, this extension of the period of delivery from all their contractors had been unavoidable.

Monopolies Report on Valves

Several Opposition members deplored the Government's failure to take action on the report of the Monopolies Commission on the supply of electronic valves and cathode ray tubes when the committee stage of the Finance Bill, which gives effect to the Budget proposals, was resumed in the House of Commons last week. During the discussion of an Opposition amendment, designed to permit licence holders to pay the new increased licence fee for sound and television in two instalments, Mr. Leslie Hale declared that the cathode ray people were "taking £7 or £8 of privateering money out of everyone who buys a set."

Mr. Harold Wilson, on behalf of the Opposition, said that if the Government had taken action on this report it might be possible to buy cathode ray tubes a little more cheaply, and it might thus be more tolerable for people in difficult circumstances to meet the extra levy which the Government were now imposing.

Mr. Enoch Powell, Financial Secretary to the Treasury, replying to the debate, agreed that the cost of replacing a cathode ray tube, as estimated by an Opposition member, was between £12 and £20, but he did not see in this any justification for accepting the proposal to divide the licence fee into instalments.

The amendment was forced to a division, and was rejected by 213 votes to 161.

Uranium in the U.K.

The Prime Minister (Mr. Macmillan) told Mr. Geoffrey Wilson that known uranium deposits in the United Kingdom were insufficient to feed even the smallest treatment plant for a single year.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) will be obtainable after 5th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

14385. Chloride Electrical Storage Co., Ltd.—Electric accumulators. 6th June, 1951. (776240.)

1951

21392. Haydon Switch, Inc.—Snap-action electric switches. 11th September, 1951. (776142.)

1953

5564. Akt.-Ges. Brown, Boveri & Cie.—Single- or multi-phase convertor set. 27th February, 1953. (776054.)

7509. National Research Development Corporation.—Electric delay lines. 15th March, 1954. (776143.)

20036. Bryce Electric Construction Co., Ltd., and Brewer, S. R. B.—Electrical testing equipment. 8th July, 1954. (776341.)

20055. General Electric Co.—Electric tilt switch and lampholder arrangements for controlling illumination of the interior of cabinets. 20th July, 1953. (776146.)

21555. Blaupunkt-Werke Ges.—Production of two-dimensional electric circuits or circuit elements on a supporting base. 4th August, 1953. (776343.)

24380. British Insulated Callender's Cables, Ltd.—Lead coated copper rods and tubes. 2nd September, 1954. (776540.)

24725. G.K.N. Group Services, Ltd.—Cutting or shaping electrically conductive materials by spark dischargers. 6th December, 1954. (776172.)

28804. General Electric Co.—Washing machines. 19th October, 1953. (776151.)

29440. Electric & Musical Industries, Ltd.—Manufacture of cathode-ray tubes. 7th October, 1954. (776441.)

32461. Enfield Cables, Ltd.—Electrical connecting plugs. 17th November, 1954. (776153.)

1954

181. Pye, Ltd.—Television receivers. 21st December, 1954. (776062.)

615. British Thomson-Houston Co., Ltd.—T.R. cells. 16th December, 1954. (776254.)

616. British Thomson-Houston Co., Ltd.—Electric-discharge devices. 16th December, 1954. (776255.)

3655. British Thomson-Houston Co., Ltd.—Recording or reproducing magnetic head. 8th February, 1955. (776348.)

6735. Genest Ges. für Isolierungen, W.—Absorbers for radio waves. 8th March, 1954. (776158.)

10366. British Insulated Callender's Cables, Ltd.—Apparatus for measuring high degrees of dryness. 6th April, 1955. (Cognate application 26661, 14th September, 1954.) (776536.)

11987. Philips Electrical Industries, Ltd.—Cathode-ray tubes. 26th April, 1954. (776351.)

12018. General Electric Co.—Vacuum tube balancing networks for metal detection systems. 26th April, 1954. (776163.)

15486. Cole, Ltd., E. K., and Hutchings, E. L.—Moving coil loudspeakers and microphones. 26th May, 1955. (776280.)

15565. Imperial Chemical Industries, Ltd.—Electronic equipment. 26th April, 1955. (776281.)

20847. Compagnie Générale de Télégraphie sans Fil.—Travelling-wave tubes having ladder delay lines. 16th July, 1954. (776072.)

22523. Siemens-Schuckertwerke Akt.-Ges.—Stage lighting switchboards. 3rd August, 1954. (776286.)

22791. Philips Electrical Industries, Ltd.—Devices comprising a closed circuit of magnetic material having high retentivity. 5th August, 1954. (776076.)

23100. McGraw Electric Co.—Magnetic core. 9th August, 1954. (776287.)

23112. Jackson Electric Stove Co., Ltd.—Joining together of two or more vitreous enamelled metal parts. 28th June, 1955. (776452.)

24239. Dunlop Rubber Co.—Push-button electrical switches. 11th August, 1955. (776288.)

24966. British Insulated Callender's Cables, Ltd.—Insulated cables and impregnating compounds therefor. 26th August, 1955. (776174.)

25220. English Electric Co., Ltd.—Magnetising windings for electrical apparatus. 26th August, 1955. (776291.)

26556. Marconi's Wireless Telegraph Co., Ltd.—Radio navigation aiding devices. 30th June, 1955. (776259.)

27177. General Electric Co., Ltd.—Electric circuit arrangements for starting and operating from an a.c. supply at least one low pressure electric-discharge lamp provided with heatable electrodes. 16th November, 1955. (776178.)

27182. Danske Securitas Aktieselskab.—Electric alarm system. 20th September, 1954. (776078.)

31618. English Electric Valve Co., Ltd.—Television camera tubes. 20th July, 1955. (776458.)

33575. Philips Electrical Industries, Ltd.—A.c. mains operated high gain low frequency electronic amplifiers. 7th September, 1955. (776188.)

33774. General Electric Co.—Cathode-ray tubes for colour production. 22nd November, 1954. (776376.)

34744. Electric & Musical Industries, Ltd.—Television cameras. 14th November, 1955. (776300.)

35253. Philips Electrical Industries, Ltd.—Methods of manufacturing semi-conductor devices. 6th December, 1954. (776301.)

37117. Philips Electrical Industries, Ltd.—Semi-conductor devices. 22nd December, 1954. (776085.)

1955

10. Cole, Ltd., E. K., and Chapman, C.—Intermediate frequency transformers. 2nd January, 1956. (776305.)

968. Philips Electrical Industries, Ltd.—Luminous voltage indicators. 12th January, 1955. (776196.)

1515. Mullard Radio Valve Co., Ltd.—Circuit arrangements for providing a d.c. output. 8th December, 1955. (776308.)

2469. Westinghouse Brake & Signal Co., Ltd., Thompson, L. E., Ashby, D., and Stevens, S. A.—Cooling of oil immersed electrical apparatus. 19th January, 1956. (776478.)

2698. British Thomson-Houston Co., Ltd.—Variable voltage transformer arrangements. 28th January, 1955. (776197.)

2999. Norsk Hydro-Elektrisk Kvaelstofaktieselskab.—Electric furnaces. 1st February, 1955. (776261.)

3316. Chloride Electrical Storage Co., Ltd.—Electric accumulators. 16th November, 1955. (776198.)

6704. Siemens-Schuckertwerke Akt.-Ges.—Dry rectifier installations. 7th March, 1955. (776311.)

8677. Harper, L.—Combination electric switches. 3rd January, 1956. (776488.)

8842/3. McGraw Electric Co.—Repeating polyphase circuit interrupters. 25th March, 1955. (776243/4.)

9564. Philips Electrical Industries, Ltd.—X-ray tubes having anode cooling by means of liquid sprayed in thin jets against the surface to be cooled. 1st April, 1955. (776208.)

9606. Landis & Gyr Akt.-Ges.—Brake magnet for electricity meters. 1st April, 1955. (776209.)

11301. General Electric Co.—Sound damping arrangement for hermetically sealed compressors. 19th April, 1955. (776094.)

13543. Metal-Lux Soc. R.L.—Process for the production of electric resistors and resistors obtained with said process. 10th May, 1955. (776214.)

13958. Telefonaktiebolaget L. M. Ericsson.—Frequency mixers. 13th May, 1955. (776098.)

13970. Compagnie Générale de Télégraphie sans Fil.—Electron discharge tubes with crossed electric and magnetic fields. 13th May, 1955. (776215.)

15163. Telefonaktiebolaget L. M. Ericsson.—LC oscillators. 25th May, 1955. (776407.)

16484. General Electric Co.—Mass spectrometers. 8th June, 1955. (776411.)

16770. Western Electric Co., Inc.—Potting of electrical apparatus. 10th June, 1955. (776216.) 17555. Electromechanical transducers. 17th June, 1955. (776498.)

19156. General Electric Co.—Circuit arrangements for deriving a unidirectional voltage from a discontinuous a.c. voltage. 1st July, 1955. (776500.)

20529. Standard Telephones & Cables, Ltd.—Modulation systems with means for reducing distortion introduced by amplifiers. 15th July, 1955. (776109.)

25522. Philips Electrical Industries, Ltd.—Frequency doubling circuit arrangement. 6th September, 1955. (776228.)

26189. Landis & Gyr Akt.-Ges.—Reactive volt-ampere meter. 13th September, 1955. (776231.)

26207. General Electric Co.—Electrical apparatus employing liquid insulation. 13th September, 1955. (776512.)

27359. Philips Electrical Industries, Ltd.—Cylindrical dispenser cathodes. 26th September, 1955. (776232.)

27899. Standard Telephones & Cables, Ltd.—Ion trap arrangements. 30th September, 1955. (776515.)

28246. Western Electric Co., Inc.—Circuits for charging electrical welding circuit capacitors. 4th October, 1955. (776426.)

28332. Standard Telephones & Cables, Ltd.—Static electrical code translating apparatus. 5th October, 1955. (776516.)

28516. Canadian General Electric Co., Ltd.—Suction cleaners. 6th October, 1955. (776517.)

31599. Standard Telephones & Cables, Ltd.—Electric cable. 4th November, 1955. (776133.)

32302. Philips Electrical Industries, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken).—Speed control of electric motor driven apparatus. 11th November, 1955. (776134.)

36479. General Electric Co.—Dish washing apparatus. 20th December, 1955. (776138.)

New Institute of Metal Finishing Branch

The inaugural meeting of the Bristol and South West Branch of the Institute of Metal Finishing will be held on 4th June. The programme includes a luncheon at the Grand Hotel, Bristol, an afternoon visit to the works of Bristol Aircraft, Ltd., and the inaugural meeting at the Grand Hotel, Bristol, in the evening.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Metropolitan Water Sewerage and Drainage Board, Sydney. 18th June. Three steam turbine driven alternators, auxiliaries and control panels at Ryde pumping station. (E.S.B. 12567/57. Ten/25954.)*

State Electricity Commission of Victoria, Melbourne. 26th June. Two or alternatively four 10 MVA, 66/6·6 kV transformers. (E.S.B. 12830/57. Ten/25951.)*

Belgian Congo.—Ministry of Colonies, Brussels. 24th June. Electrical equipment for technical school at Leopoldville, including transformers, alternators, convertor set, etc. (E.S.B. 12665/57. Ten/25917.)*

Burma.—Burma Purchase Board, Rangoon. 6th June. Single way and double pole main switches. (E.S.B. 13057/57. Ten/25996.)* 10th June. Telephone and loudspeaker equipment. (E.S.B. 13062/57. Ten/26005.)* Metal rectifier battery charging units. (E.S.B. 13063/57. Ten/25999.)*

Durham.—County Council. 12th June. Electrical installation at Consett Technical College. (See this issue.)

Formosa.—Central Trust of China, Taipei. 17th June. Electrical apparatus and telephone equipment. (E.S.B. 12484/57.I.C.A. Ten/25905.)*

Goole.—Corporation. 14th June. Street lighting equipment. (See this issue.)

Greece. — State Procurements Service, Athens. 6th June. Thirty-two 2·5 kW petrol-driven generators. (E.S.B. 12680/57. Ten/25957.)*

India.—Nangal Fertilizers and Chemicals Private, Ltd. 15th June. Seven 35,000 kVA transformers and twenty rectifiers. (E.S.B. 12723/57. Ten/25932.)*

Government of Mysore Stores Purchase Committee, Bangalore. 30th June. 66 kV transmission line and accessories. (E.S.B. 12882/57. Ten/25950.)*

Madhya Pradesh Electricity Board, Nagpur. 26th June. Power and control cables and earthing materials. (E.S.B. 11966/57. Ten/25948.)*

Iraq.—Directorate General of Municipalities, Baghdad. 8th June. Cable and cable boxes. (E.S.B. 13160/57. Ten/26031.)*

New Zealand.—Post and Telegraph Department, Wellington. 19th June. Relay switches. (E.S.B. 12851/57. Ten/25962.)* 25th June. Receiving, rectifying and transmitting valves. (E.S.B. 12854/57. Ten/25949.)* 16th July. Vacuum cleaners and floor polishing machines. (E.S.B. 12852/57. Ten/25967.)*

South Africa.—Stores Department, South African Railways, Johannesburg. 14th June. Telegraph line material. (E.S.B. 12505/57. Ten/25901.)*

South West Africa.—South West Africa Tender Board. Windhoek. 7th June. Electric conduit tubing and conduit boxes. (E.S.B. 12670/57. Ten/25916.)*

Turkey. — International Co-operation Administration. 14th June. Motors, deep well pumps, poultry equipment, etc. (E.S.B. 12899/57.I.C.A. Ten/25979.)*

United States.—Department of the Interior, Bonneville Power Administration, Oregon. 13th June. Copper control cable and wire. (E.S.B. 13012/57. Ten/25992.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Bradford.—Public Works (Housing Sub-Committee). Electrical work on the Wood Side estate (scheme No. 45) in lieu of the tender of B. D. C. Morley (withdrawn) (£16,066).—J. Carter & Sons (Bradford). (In lieu of tender of B. D. C. Morley withdrawn).

London.—Stepney Corporation. Recommended. Electrical installation work in blocks 10 and 10a at the Sidney Street housing scheme (£2,992).—Holliday, Hall & Stinson.

Luton.—Corporation Housing Committee. Recommended. Electrical installation work in 78 flats to be erected in New Town Street (£3,165).—L. C. Sturgess.

Peterborough.—Electrical work in 124 houses and 34 bungalows, Bluebell and Park Lane estates (£3,294).—M. F. Hansen.

Peterlee (Durham).—Development Corporation. Electrical installations in 208 houses at Acre Rigg.—J. Calvert.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Barnsley.—Works extensions; W. Sutcliffe & Co., Ltd., Stanley Road, Stairfoot.

Bedlington. — Miners' hall (£25,000); N.C.B. Architects' Department, Whitley Road, Longbenton, Northumberland.

Houses (152) for U.D.C.; Myton, Ltd., contractors, Hull.

Brigg.—Secondary modern school, Westmoor Road; A. Clark, county architect, County Offices, Newland, Lincoln.

Cardiff.—Houses (95), on sites at Ely North and Fairwater; city architect, City Hall.

Chadwell Heath.—Warehouse, laboratories and canteen; Lewis Berger (Great Britain), Ltd., Freshwater Road.

Cheetham (Manchester).—Two-storey factory, Chatley Street site; P. Cummings, architect, 16, Oxford Street, Manchester, 1.

Cheltenham.—Works extensions; Alfred Miles, Ltd., Tewkesbury Road.

Flats (30), Alma Road; Western Estates, Ltd., Norwood Road.

Croydon.—Houses (126), second stage redevelopment of Longheath estate; E. Taberner, Town Clerk, Town Hall.

Dagenham.—Houses (224), Canvey Island redevelopment; Harry Brompton, consulting engineer, 7, Hobart Place, Westminster, London, S.W.1.

Dorchester.—Admission block at Herrison Hospital (£205,000); Gollins, Melvin, Ward & Partners, architects, 15, Manchester Square, London, W.1.

Dublin.—Multi-storey office block; D. Rea O'Kelly, architect, 15, Fitzwilliam Square.

Dudley.—Houses (150), Russells Hall site; borough architect.

Durham.—Technical college at Durham (2nd instalment) (£310,000); G. W. Lazenby & Co., Ltd., builders, Ferryhill, Co. Durham.

Eastbourne.—Flats (56), King Edward's Parade; H. Hubbard Ford, architect, 24a, Cornfield Road.

Edmonton.—Rebuilding factory premises; Klingers Manufacturing Co., Ltd., Silver Street.

Enfield.—Hall and classrooms, Shirley Road; H. H. Clark, architect, 7, Victoria Street, London, S.W.1.

Factory, Ponders End; Le Bas Tube Co., Ltd., 129, Finsbury Pavement, London, E.C.2.

Felling (Co. Durham).—Multi-storey flats, Crowhall Road; R. Morton, U.D.C. surveyor.

Guildford.—Rebuilding premises, 173-4, High Street; Lymposs & Smee, Ltd., dairy farmers, Chertsey Street, Guildford.

Hereford.—Houses (240), and old people's dwellings (12), Green Lanes estate; city surveyor, Town Hall.

Works extensions; Denco Engineering Services, Ltd., Holmer Road.

Jarrow.—Additions to Jarrow Grammar School (£157,000); G. Bainbridge, Ltd., builders, 205, West Road, Newcastle-on-Tyne.

Leeds.—Departmental store, Theatre Royal site; Schofields (Leeds), Ltd., The Headrow.

Liverpool.—Extensions to College of Art (£135,000); Morrison & Sons, Ltd., builders, Grange Terrace.

London. — Departmental store, 376-84, Oxford Street; C. & A. Modes, Ltd., North Row, W.1.

Reinstatement of Rivoli Cinema, Whitechapel Road; Geo. Coles, architect, 40, Craven Street, W.C.1.

Lurgan (Northern Ireland).—Factory for Ministry of Commerce; Houston & Beaumont, architects, 9, Market Square.

Maghull (Lancs.)—Police headquarters, Northway; county architect, County Offices, Fishergate Hill, Preston.

Mangotsfield.—Dwellings (48) for U.D.C.; F. Wallace, Council Offices, Staple Hill, Bristol.

Morley.—Flats (48), Bridge Street; borough surveyor.

Newcastle-on-Tyne. — Flats (156), near Wharrier Street; G. Kenyon, city architect, 18, Cloth Market.

Northampton.—Adaptation of premises, Park Parade, as home for old people (£61,000); borough architect.

Northumberland.—Fire station at Belford; county architect, County Hall, Newcastle-on-Tyne.

Oldham.—Houses, flats and bungalows (110), Alt estate; Cameron & Middleton, architects, 21, Queen Street, Oldham.

Oxford.—Houses (367) and block of shops, Blackbird Leys; city architect, Town Hall.

Pershore.—County primary infants' school (£38,777); W. A. Cox (Evesham), Ltd., builders, Abbeygate, Evesham.

Peterlee.—Health centre (£45,000); county architect, Durham.

Redditch.—Dwellings (84), Vaynor estate; Farmer, Beasley & Co., 33, Paradise Street, Birmingham.

Rochford.—Twin operating theatre suite, General Hospital; W. G. Plant, architect, 3, Queen Anne Street, London, W.1.

St. Helens.—Houses (182), Derbyshire Hill estate; borough engineer, Town Hall.

Salford.—St. Lawrence C.E. Secondary School; John Dickinson & Co., Ltd., builders, Fairclough Street, Bolton.

South Shields.—Houses (51), Ravensworth Terrace; borough engineer.

Stockton-on-Tees. — Secondary modern school, Junction Road; borough architect, 28, The Square.

Sunderland.—Office block, John Street; W. and T. R. Milburn, architects, 18, Fawcett Street, Sunderland.

Sutton Coldfield.—Houses and bungalows (30), Boldmere; borough surveyor, Council House.

Swansea.—First stage of new General Hospital, Singleton Park; Welsh Regional Hospital Board, 5, Museum Place, Cardiff.

Tendring.—Flats (144), houses (16), bungalows (16), and shops, etc., Colchester Road area, Lawford; R.D.C. surveyor, Council Offices, Weeley, Essex.